A Dissertation on

PROFILE OF MICROALBUMINURIA IN NON DIABETIC MYOCARDIAL INFARCTION

Submitted to
THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI – 600 032.

In fulfillment of the Regulations
For the Award of the Degree of

M.D. GENERAL MEDICINE

BRANCH - I, PART - II

DEPARTMENT OF GENERAL MEDICINE
KILPAUK MEDICAL COLLEGE
CHENNAI – 600 010.

SEPTEMBER 2006

CERTIFICATE

This is to certify that **Dr. A.ARVIND,** Post -Graduate Student (July. 2003 to September 2006) in the Department of Medicine, Kilpauk Medical College, Chennai- 600 010, has done this dissertation on **"PROFILE OF MICROALBUMINURIA IN NON DIABETIC MYOCARDIAL INFARCTION)"** under my guidance and supervision in fulfillment of the regulations laid down by the Tamilnadu Dr.M.G.R. Medical University, Chennai, for M.D. (General Medicine), Degree Examination to be held in September 2006.

Prof. K.S. SAIKUMAR, M.D.,
Professor & HOD
Department of Internal Medicine,
Kilpauk Medical College Hospital
Chennai.

Dr. THIYAGAVALLI KIRUBAKARAN M.D.,
The Dean
Kilpauk Medical College
Chennai 600 010**.**

Date :

Station : Chennai.

ACKNOWLEDGEMENT

I am very much thankful to the Dean, Government Kilpauk Medical College, Chennai for granting me permission to utilize the facilities of the hospital for the study.

I express my thanks to my esteemed Professor and Teacher **Prof. K.S.SAIKUMAR, MD.,** Professor and Head of the Department of Medicine, Government Kilpauk Medical College Hospital, for extending invaluable guidance to perform and complete this dissertation.

I thank**, Prof. S.R.SHAKUNTHALA, M.D.** Professor ,Department of Medicine, Kilpauk Medical College Hospital, for her guidance and encouragement during this study.

I wish to thank **Dr.Rajashekhar M.D.** and **Dr.Jayakumar M.D. , Dr.A.Joseph Navaseelan M.D., Dr. S. Ramasamy M.D.,**Assistant Professors, Department of Medicine, for their valuable suggestions, encouragement and advice.

I thank all our Postgraduates, House Surgeons, Staff of our College for their contribution in this study.

CONTENTS

INTRODUCTION

Coronary Heart Disease has been defined by WHO as 'Impairment of heart function due to inadequate blood flow to the heart compared to its needs, cause by obstructive changes in coronary flow'. Coronary heart disease [45,46] contributed 15.3 million deaths in 2000, accounting for 30% of the global death toll that year. They accounted for 45.6% of all deaths in the developed countries and 24.5% of all deaths in the developing countries. In absolute numbers the developing countries contributed 9.77 million deaths due to CHD, in contrast to 5.52 million in developed countries (an excess of 76%).

Apart from the excess absolute mortality the early age of CHD related deaths in the developing countries is also a cause for concern. In a large country like India, more than half of the CHD deaths (52.2%) occurred below 70 years. Indians around the globe have the highest rates of morbidity and mortality from coronary artery disease (CAD), despite the fact that nearly half of them are lifelong vegetarians. CAD rates among Indians are 2 to 4-fold higher overall and 5 to 10-fold higher in those younger than 40 years of age, irrespective of gender, region, religion, or social class. High level of lipoprotein (a) provides the nature of genetic susceptibility. Unhealthy life-style associated with affluence, urbanization and mechanization adds to the problem. During the past 30 years, CAD rates in most developed countries have declined by 30-60% as a result of population –wide reduction in risk

factors along with advances in the medical management. Reduction in risk factors explains more than half the decline. Ironically, the CAD rates doubled in India during the same period, primarily due to dietary changes associated with transition from a rural sustenance economy to an urban oriented economy.

Myocardial infarction accounts for 33% of the total mortality associated with coronary artery disease. Half of the victims die before reaching the hospital. Early recognition and prompt treatment significantly reduce the mortality and morbidity of Myocardial infarction. Atherosclerotic changes in the coronary arteries are the most important cause for Ischemic Heart Disease. There are certain well known risk factors for atherosclerosis as,

Family history, Hypertension, Diabetes Mellitus, Cigarette smoking, Low HDL concentration, Old age, Male gender, Hyperfibrinogenemia, Hyperhomocysteinemia, Physical inactivity, Obesity.

Diabetes mellitus has been proved to be a very strong risk factor for coronary heart disease. In the last decade, a series of longitudinal studies have shown that increased urinary albumin excretion below the level of clinical albuminuria, so called microalbuminuria strongly predicts development of nephropathy in Diabetes mellitus. Microalbuminuria defined as albumin excretion 20-200µ gm/mt or 30-300 mg /day in urine is considered a novel atherosclerotic marker. Microalbuminuria reflects a more generalized

pathological process of the vascular system affecting the glomeruli, retinal vessels, and the intimal larger vessels simultaneously. The association between microalbuminuria and peripheral markers of endothelial damage or dysfunction, such as Von Willebrand factor, and its association with lipoprotein (a), insulin resistance etc. Suggests the possibility that microalbuminuria may be a simple cheap and easy index of endothelial abnormalities in cardiovascular disease.

AIMS AND OBJECTIVES

1. To estimate the incidence of microalbuminuria in nondiabetic patients with at least one Myocardial Infarction in past 2 years.
2. To determine whether microalbuminuria is an independent marker of Myocardial Infarction in nondiabetics.
3. To correlate the incidence and severity of microalbuminuria with
    a. Detailed physical examination to detect any particular finding significantly correlating with microalbuminuria.
    b. Various hematological and biochemical parameters.
    c. Echo changes of systolic and diastolic dysfunction.

REVIEW OF LITERATURE

The evidence for proteinuria in diabetic patients dates back to 18th century. In 1836 Bright postulated that albuminuria could reflect a serious renal disease specific to diabetes[7]. In the 1930's Kimmelstiel and Wilson described the characteristic pathological lesion of kidneys in long standing Diabetes[8]. During the last decade, several longitudinal studies have shown that increased urine albumin excretion below the level of clinical albuminuria i.e. microalbuminuria strongly predicts development of nephropathy in Diabetic population[10]. Recent studies have shown association of microalbuminuria with diverse conditions like cardiovascular disease[1],[2], endothelial dysfunction[4], insulin resistance[11], systemic hypertension[12,13], coronary artery disease[14] and dyslipidemias[15].

MICROALBUMINURIA – DEFINITION

The term microalbuminuria was coined in Guy's hospital in London in 1982[16]. It has been defined as urinary albumin excretion

>30 mgm/24hr.(20µgm/mt)

≤ 300mgm/24hr. (200µgm/mt)

irrespective of how sample is collected.

PATHOPHYSIOLOGY AND PATHOGENESIS

The glomerular – capillary blood urine barrier can be regarded functionally as a membrane perforated by pores of an average size of 5.5 nm

and with uniform charge. Passage of molecules across the glomerular basement membrane depends on size and charge of particle and a set of metabolic factors and hemodynamic factors acting on it.

Metabolic factors – In diabetes, Advanced Glycated End products (AGE), polyol pathway, protein kinase C which all may induce tissue injury, lead to decreased charge selectivity of glomerular basement membrane, loss of glomerular fixed negative charges, extra cellular matrix cross linking and activation of cytokines.

Hemodynamic factors –Vasoactive hormones like endothelin and angiotensin II, AGE, Glucose, TGF-β all have been implicated among the hemodynamic factors causing albumin leakage.

Among these, the change in charge selectivity has support in the studies made by Kofoed – Enevoldsen et al.[47] in 1996. The primary population in this cross –sectional study was 124 subjects aged 40 to 75 years without glucose intolerance and with a previous (3 years before the present study) urinary albumin excretion rate (UAE) in the normal (<20 microgram/min) or microalbuminuric (>20 microgram/min) range. The secondary population consisted of 39 offspring aged 15 to 40 years. The main outcome measures included UAE, urinary IgG/lgG4 selectivity index (SI), and the presence of ischemic heart disease as determined by questionnaire or ECG. A significant inverse correlation was found between SI and UAE. The reduction in SI was found with increasing age, independent of UAE. In non

diabetic subjects the development of microalbuminuria is associated with reduced SI, suggesting impairment of glomerular charge selectivity.

MICROALBUMINURIA & ATHEROSCLEROTIC DISEASES

Mongensen CE[17] in Denmark and Jarrett[18] et al in Britain were the first to explore the role of microalbuminuria as a marker of cardiovascular risk factors, in patients with NIDDM.

The association between microalbuminuria and cardiovascular mortality is not confirmed to diabetic individuals only microalbuminuria predicts vascular disease in non-diabetic population makes it a more universal marker of early death from cardiovascular disease in humans. Yudkin et al had shown as 24 fold increase in mortality since it has been recently shown to extend to general population by Winocour et al.[19]

Indeed the demonstration by Yudkin et al[1] that rate in people with microalbuminuria. This observation has been tried to be explained by Deekert et al in the Steno hypothesis in diabtologia 1989[20] as follows- 'Microalbuminuria is caused by loss of negative charge of glomerular basement membrane, permitting leakage. Similar changes occur in blood vessels that allow atherosclerotic lipoproteins to enter vessel wall'. In other words, microalbuminuria reflects a glomerular manifestation of an otherwise generalized vascular hyperpermeability state.

Other workers have reported association of microalbuminuria with lipid abnormalities (increased Lp(a) & decreased HDL)[15]. Stehouwer et al reported a high von Willebrand factor in relation to urinary albumin excretion and cardiovascular disease. Coller et al[22] also noted high VWF levels and increased free radical activity in NIDDM with microalbuminuria. Thus the onset of microalbuminuria signals highly athrogenic milieu in both diabetics and nondiabetics.

The association of microalbuminuria and atherogenic risk factors was also studied in 1998 by Kim et al[48]. They studied cross-sectionally 497 clinically healthy non-diabetic subjects more than 40 years of age who lived in Korea for the prevalence of microalbuminuria and various cardiovascular risk factors. Subjects with microalbuminuria had significantly higher values in age, BMI, waist –hip-ratio in females, blood pressure, plasma cholesterol and fasting plasma insulin. Multiple logistic regression analysis when applied showed these were independently associated with microalbuminuria.

Jensen JS et al[49] in 1995 also studied the association between microalbuminuria and atherosclerotic risk factors. They studied 40-65 years old clinically healthy subjects, all of them participants of Copenhagen city heart study and found that in the microalbuminuric group systolic and diastolic blood pressures were both elevated and serum apolipoprotein (apo)A-1 concentration was lower, also serum HDL cholesterol tended to be low, whereas body weight, BMI and serum fasting insulin was elevated.

They concluded that microalbuminuria in clinically healthy subjects is associated with increased levels of atherogenic risk factors.

In the D.E.S.I.R study Mennen LI[50], et al studied the relationship between microalbuminuria and tissue-type plasminogen activator antigen (tPA-ag) and fibrinogen in non diabetic subjects. The results of this study suggest that in non-diabetic men, microalbuminuria is associated with fibrinogen, but with tP-A-ag only when concomitant with hypertension.

MICROALBUMINURIA AND ESSENTIAL HYPETENSION

Prevalence of microalbuminuria in hypertension has been reported over a wide range in studies all over the world. The level of albuminuria is more closely associated with ambulatory blood pressure. The interaction between albumin excretion and BP is enhanced by obesity and smoking. Hypertensive with higher Body Mass Index and high waist – hip ratio had high prevalence of microalbuminuria which was shown by Bonnet J. et al 2001, Donovan SJ 2000, Campese VM et al 2000. Although the true relevance of microalbuminuria as a marker of cardiovascular risk or hypertensive renal damage needs to established, it appears to be a significant risk factor.[24,31]

Microalbuminuria may be an early indicator of target organ damage namely, LVH, retinal vascular lesion, increased carotid artery wall thickness and glomerular hyperfiltration. Microalbuminuria is also associated with

abnormal circadian pattern of blood pressure ie higher 24 hours mean level, Low day: night ratio (non –dipper) and hyper variability of pressure readings.[23] Thus in essential hypertension, microalbuminuria is a marker of the presence of high blood pressure throughout 24 hours period. West JN 1991 and Gosbing P et al 1991; found a direct correlation between grading of microalbuminuria and staging of essential hypertension.

To identify biological co-variates of microalbuminuria in non-diabetic subjects, brachial BP, echocardiographic left ventricular mass and other cardiovascular and metabolic parameters were evaluated in 211 untreated males (38 normal controls, 109 uncomplicated stage 1 to 3 essential hypertensive and 64 patients with stable atherosclerotic peripheral vascular disease either with (n=44) or without (n-20) essential hypertension with normal cardiac and renal function). Compared with nonalbuminurics, microalbuminurics had high systolic BP,comparable diastolic pressure and so high pulse pressure. Greater prevalence of hypertension, peripheral vascular disease, LVH and decreased HDL cholesterol further distinguished microalbuminuria from non-albuminuria in univariable comparison. This association of microalbuminuria with wider pulse-pressure, a correlate of pulsatile hemodyamic load and conduit vessels stiffness as well as an important cardiovascular risk factors, may explain why microalbuminuria predicts cardiovascular events in non diabetic subjects.

The association of microalbuminuria with pulse pressure and isolated systolic hypertension was demonstrated by Cirillo M> et al in the GUBBIO study Collaborative Research Group.[25] The study shows the relationship of pulse pressure and isolated systolic hypertension to microalbuminuria in non-diabetic subjects. Overnight urinary albumin and creatinine excretion, fasting plasma glucose, cholesterol, weight, height, medical history and smoking habits were studied. It demonstrated that in non –diabetic middle aged adults, isolated systolic hypertension and pulse pressure is directly related to microalbuminuria independent of diastolic pressure and other correlates.

MICROALBUMINURIA AND ENDOTHELIAL DYSFUCTION

Yudkin JS et al had demonstrated in 1988 that microalbuminuria is a predictor of vascular disease in even non-diabetic subjects. The steno hypothesis in Diabetologia 1989 suggested microalbuminuria reflects a glomerular manifestation of an otherwise generalized vascular hyperpermeability state. The pathophysiology of increased transcapillary escape rate of albumin (TER-alb) is unknown but could be caused by hemodynamics or damage to the functional properties of the vascular wall. A number of studies has provided incidence of endothelial dysfunction in patients with microalbuminuria. In this context a number of markers of endothelial cell dysfunction have been found to be increased in patients with microalbuminuria.

Microalbuminuria is considered a novel atherosclerotic risk factor. This is supported by two preliminary minor studies.

- Copenhagen City Heart Study and
- MONICA Population study. The aims of these were-

1. To examine whether a relationship exists between microalbuminuria and atherosclerotic cardiovascular disease in the general population.
2. To illuminate possible pathophysiological mechanism underlying this association.

In this 3rd Copenhagen City Heart Study a cross sectional analysis comprising 2613 individuals without diabetes mellitus or renal / urinary tract disease revealed a positive association between overnight urinary albumin excretion rate and a history of acute myocardial infarction. This association was independent of age, sex, conventional atherosclerotic risk factors and GFR. Participants with albumin exertion rate exceeding upper value of (>7µg.ml) in the entire population had higher frequency of previous acute myocardial infarction than others.

In the 1st Monica Population study in Copenhagen , 2085 individual without diabetes, cardiovascular disease, renal / UTI were followed for 10 years. Participants with high albumin/ creatinine ratio had a relative risk of 2.3 for developing IHD. This was observed independent of age, sex and

conventional atherosclerotic risk factors. Measurement of glomerular filtration rate and tubular function made it unlikely that the difference in urinary albumin between the two study groups was due to local renal conditions, although reduction in both glomerular charge selectivity and size selectivity were observed in microalbuminuric individuals. Individuals with microalbuminuria had increased transvascular albumin leakage to a level similar to that seen among individual with clinical atherosclerosis. This was not explainable by difference in BP, lipoprotein levels, plasma volume, albumin concentration, anthropometry, insulin sensitivity or smoking habits. It is hypothesized that the systemic transvascular leakiness may also include lipoproteins, thus allowing for an increased lipid transudation into the vessel walls. The leakiness might be due to hemodynamic factors of structural or functional perturbations of the endothelium. Further studies may demonstrate the exact nature of endothelial dysfunction.

Jensen JS et al in 1995[51] at the Steno Diabetes Center in Denmark conducted a study to test the hypothesis that microalbuminuria in clinically healthy subjects is associated with a systemic transvascular albumin leakiness. They found that the positive correlation between urinary albumin excretion rate on continuous scale and the fractional disappearance rate of albumin from plasma compartment was independent of age, sex, smoking status, blood pressure, body size, plasma volume, plasma albumin concentration and concentrations of blood glucose, serum insulin and serum

lipids. In conclusion, microalbuminuria is an independent marker of systemic transvascular albumin leakiness in clinically healthy subjects.

Garg JP et al[53] 2002 has also described microalbuminuria as a marker of vascular dysfunction and risk factors for cardiovascular disease. They have described microalbuminuria as a signal from the kidney that cardiovascular risk is increased and the vascular responses are altered. They suggested that a reduction in the rise of microalbuminuria is a significant consideration in the selection of agents to treat a given risk factor (cholesterol or blood pressure) to a recommended target goal.

Pedrinelli R, et al 2001[54] studied microalbuminuria in non diabetics and observed that microalbuminuria might be considered as an integrated marker of cardiovascular risk sensitive to systemic vascular status in addition to other parameters such as blood pressure levels, glucose metabolism, smoking habits, a profile rather unique among the prognostic predictors available to stratify risk in hypertensive patients.

MICROALBUMINURIA AND INSULIN RESISTANCE

Reaven (1998) has proposed that insulin resistance/ hyperinsulinemia is the common denominator between conventional cardiovascular risk factors and development of atherosclerosis. Thus individual risk factors such as hypertension, obesity, hyperlipidemia and glucose intolerance commonly contribute to form a clinical syndrome characterized by underlying state of

insulin resistance and devastating cardiovascular outcome, which Reaven referred to a s syndrome X. There is now evidence to promote microalbuminuria as a distinct and independent facet of this disorder.

Niskanen L et al[28] proved the association of NIDDM with microalbuminuria, while Forsblom CM et al in their study in 1995[29] proved that microalbuminuria and insulin resistance existed in non-diabetic first degree relatives of people with NIDDM. The Insulin Resistance Atherosclerosis study (IRAS) 2000[30] studied the relationship of microalbuminuria with two well known markers of inflammation – CRP and Fibrinogen. Both were related with significant association after adjustment for demographic variables, diabetic status, smoking and use of ACE inhibitors. It showed association of CRP and fibrinogen with microalbuminuria in non – diabetic individuals.

MICROALBUMINURIA –CORRELATION WITH IHD AND ATHEROSCLEROTIC RISK FACTORS[31]

The association of microalbuminuria with vascular disease has been reported in diabetic and non-diabetic individuals. It has been suggested that microalbuminuria reflects a more generalized pathological process of the vascular system affecting the glomeruli, retinal vessels and the intimal larger vessels, simultaneously.

Jensen JS et al in 1997 made a population based study of 1254 hypertensive patients at Epidemiological Research Unit.[33] at the State University Hospital, Copenhagen. The aim of this study was a cross – sectional analysis to show whether microalbuminuria is related to a higher prevalence of cardiovascular disease, a more atherogenic risk profile and reversibly related to the use of antihypertensive drugs. The study showed microalbuminurics to have higher age, systolic BP, male predominance as compared to others. It was concluded that slightly elevated albumin excretion in the urine is not only a pressure dependent functional phenomenon, but associated with permanent atherosclerotic damage in the entire vascular system.

Taskiran M. et al in 1998[55] studied urinary albumin excretion in hospitalized patients with acute myocardial infarction at the Department of Cardiology, Copenhagen. The aim of this study was to measure the urinary albumin excretion in patients with acute myocardial infarction, and to correlate this with known atherosclerotic risk factors. 126 patients and 56 healthy controls matched for age and sex were studied. The albumin /creatinine concentration ratio in morning urine specimens was calculated as an index of the albumin excretion. The frequency of microalbuminuria was higher in patients than controls. This difference was independent of blood pressure, body weight, smoking, diabetes mellitus, renal disease and thrombolytic treatment. There was a positive correlation between urinary albumin excretion and thickness of the left ventricle wall, which was

independent of blood pressure. Follow –up examination of the patients will reveal whether microalbuminuria increases the risk for recurrence of acute myocardial infarction.

MICRO-HOPE STUDY

To describe the characteristics of diabetics and non-diabetics in the Heart Outcome Prevention Evaluation (HOPE) study who are at high risk to develop cardiovascular disease and who have microalbuminuria and to identify the key determinants of microalbuminuria in these two groups – MICRO- HOPE [34] (microalbuminuria, Cardiovascular and renal outcome) sub study was done.

Albuminuria was measured in 97% of patients enrolled in HOPE study. Baseline clinical characteristics of diabetic and non-diabetic participants with microalbuminuria were recorded and univariate and multivariate relationship between these characteristics and the presence of microalbuminuria was estimated for both groups. It was concluded that microalbuminuria is independently associated with several risk factors for cardiovascular and renal disease in both diabetic and non-diabetic at high risk for cardiovascular disease.

PREVENDIT [35]

The American Journal of Cardiology describes the rationale, design and baseline characteristics of a trial to determine whether treatment with

fosinopril 20mg in a day and or pravastatin 40 mgm a day will prevent cardiovascular and renal disease in non-hypertensive (BP<160/100 mm Hg not on antihypertensives) and nonhypercholesterolemics (Tch<8.0 mmol or <5.0 mmol in previous MI) not on lipid lowering drugs, men and women with microalbuminuria. The PREVEND IT. Studied 864 randomized subjects for a minimum of 4 years and maximum 5 years. The primary efficacy parameter was defined as the combined incidence of all cause mortality or hospital admission for documented-

1. Nonfatal myocardial infarction
2. Myocardial ischemia
3. Heart failure
4. Peripheral vascular disease
5. Cardiovascular disease
6. End stage renal disease.

Haffner SM et al has studied the relationship of microalbuminuria with cardiovascular disease in the San Antonio Heart Study[36] a population based study of 316 non-diabetic subjects. Microalbuminuria was significantly associated with higher blood pressure, triglyceride concentration, sum of insulin concentrations during a glucose tolerance test, and prevalence of hypertension and of self reported myocardial infarction. When subjects with hypertension were excluded, normotensives with microalbuminuria still had significantly higher triglyceride levels and serum insulin, suggesting that in

increased atherogenic risk factor pattern exists even in normotensive subjects with microalbuminuria.

Taskiran M[37] et al have studied the incidence of urinary albumin excretion in hospitalized patients with acute myocardial infarction. They have demonstrated a positive correlation between urinary albumin excretion and left ventricle wall thickness which was independent of blood pressure. The difference was independent of blood pressure, body weight, smoking, diabetes, renal disease and thrombolytic treatment.

The Risk Factors Intervention study Group at Wallenberg Laboratory for Cardiovascular Research, Sahlgrenska University Hospital, Goteborg University, Sweden investigated the predictive value of microalbuminuria as a risk factor for true major cardiovascular events in non-diabetics with treated hypertension. In a prospective study over a period of 3.3 years, overnight urinary albumin was measured in 345 non diabetics with treated hypertension, aged 50-72 years, either with serum cholesterol $\geq$ 6.5 m mol/L or smokers or both- This study proved microalbuminuria was associated with future major cardiovascular events.

Boehringer Mannheim GmbH, Germany tested the hypothesis that qualitative microalbuminuria screening in a practice setting would identify non-diabetic hypertensive patients at high risk of developing cardiovascular disease. It studied 11.343 patients, of whom 25% had coronary artery disease,

17% had LVH, 5% had a stroke, 6% had peripheral vascular disease. Of these 32% showed presence of microalbuminuria.

MICROALBUMINURIA IN NON DIABETICS

Microalbuminuria in non diabetics was first described by Yudkin JS et al 1988[58] in the Islington Diabetes Survey. It was noted by logistic regression that diabetes, impaired glucose tolerance, systolic and diastolic blood pressures, smoking, age, sex, ethnic origin, and body mass index, were independently related to microalbuminuria and coronary heart disease even in non diabetics.

The Gubbio Population Study[56] done by Cirillo M et al 1998 also studied microalbuminuria in nondiabetic adults in relation of blood pressure, body mass index, cholesterol levels and smoking. They tested the hypothesis that in nondiabetic middle –aged adults without macroalbuminuria, cardiovascular risk factors are related to urinary albumin excretion and prevalence of microalbuminuria. There were 1567 participants in the Gubbio population Study (677 men and 890 women) aged 45 to 64 years, without macroalbuminuria, without diabetes mellitus and with fasting plasma glucose levels less than 140 mg/dl. Data collection included albumin and creatinine excretion, level of fasting plasma cholesterol, glucose, triglycerides, creatinine and uric acid, creatinine clearance red blood cell sodium- lithium counter transport; blood pressure, weight, height, medical history, smoking status, and alcohol intake. The conclusion of this study was that major

cardiovascular risk factors are independent correlates of microalbuminuria in non diabetic middle aged adults. Kim CH et al[48] also studied association of microalbuminuria and atherosclerotic risk factors in non-diabetic subjects.

Hillege HL, et al in 2001[57] described that microalbuminuria is common, also in a nondiabetic, nonhypertensive population, and is an independent indicator of cardiovascular risk factors and cardiovascular morbidity in the Journal Intern Med. The study was done to assess the prevalence of microalbuminuria in the general population especially in nondiabetic and nonhypertensive subjects, and its association with known cardiovascular risk factors and cardiovascular morbidity. In this cross sectional cohort study, cardiovascular risk factors and morbidity were validated in a well defined nondiabetic and nonhypertensive group of 5241 subjects. Microalbuminuria was present in 7.2% of the subjects and independently associated with age, gender, hypertension, diabetes, smoking, previous myocardial infarction and stroke. It concluded that microalbuminuria appears to be common not only in the general population but also in a nondiabetic, nonhypertensive population and is independently associated with increased cardiovascular risk factors and cardio- vascular morbidity.

MICROALBUMINURIA AND PERIPHERAL ARTERY DISEASE ASSOCIATION WITH CARDIOVASCULAR MORTALITY – HOORN STUDY.

Microalbuminuria is associated with increased cardiovascular and all cause mortality. It has been proposed that microalbuminuria reflects generalized atherosclerosis and may thus predict mortality. To investigate this hypothesis, Hoorn study, studied the associations between, on one hand microalbuminuria and peripheral artery disease, a generally accepted marker of generalized atherosclerosis and on the other hand, cardiovascular and all cause mortality in an age, sex and glucose tolerance stratified sample (n=631) of a population cohort aged 50-75 followed preoperatively for 5 years. Both microalbuminuria and peripheral artery disease were associated with a 4-fold increase in cardiovascular mortality. After adjusting for age, sex, diabetes mellitus, hypertension, cholesterol levels, body mass index, smoking habits and previous IHD the relative risks were 3.2 for microalbuminuria and 2.4 for PAD. It concludes that both microalbuminuria and PAD are associated with an increased cardiovascular mortality. Microalbuminuria and PAD are mutually independent risk factors. These data suggests that microalbuminuria affects mortality risk through a mechanism different from generalized atherosclerosis.

MICROALBUMINURIA – IN THE ELDERLY

Studies over the past decade depict that incidence of microalbuminuria increases with age. Elderly hypertensives have higher prevalence of microalbuminuria than younger subjects[38] (Agarwall et al 1995).

Bone J et al 2001 showed that microalbuminuria positively correlated with age, systolic BP, body mass index waist to hip ratio, pulse pressure, decrease HDL cholesterol, increase triglycerides.

Agarwall B et al 1996([39] in the Journal Hypertension showed increased age correlates with microalbuminuria.

Reports of Copenhagen study group – Jensen J S et al[33] 1997 showed higher age to be associated with microalbuminuria.

MICROALBUMINURIA – WITH HEIGHT AND SEX

Studies all over the world show a male preponderance in sex distribution of microalbuminuria. Regarding height, microalbuminuria is seen associated with short stature.

The Copenhagen study group[33] has shown association of microalbuminuria with short stature and male sex. Similar observations have also be made by Gould MM et al, 1993.

Male preponderance in microalbuminurics have also been shown by Mortin J et al 1996.[41]

MICROALBUMINURIA – ETHNIC DIFFERENCES

In NIDDM, prevalence of microalbuminuria has been shown to be 7.6% in English and 42% in Norway population.[42]

High rate and poor outcome is seen of diabetic nephropathy in nonwhite population than in whites. Summerson JH et al 1995 showed that black hypertensives had significantly higher urinary albumin excretion rates compared to whites.

MICROALBUMINURIA AND OBESITY

Obese subjects have higher prevalence of microalbuminuria than non obese ones. This has been shown in subjects with hypertension in a number of studies of Bonet J et al 2001, Donovan SJ et all 200, Agarwall S et al 1993, MImran et al 1996.[24] The association of microalbuminuria with body weight has also been shown in patients of acute myocardial infarction by Taskiran M> et al in 1998 .[58] In the Gubbio Population study 1998 Cirillio M et al[56] noted that microalbuminuria is associated with high BMI in non diabetics. Kim CH et al[48] in 1998 also had made similar observation.

MICROALBUMINURIA AND SMOKING

Microalbuminuria is more prevalent in smokers than in non smokers.

Mimam et al 1997 [24] stated the higher prevalence – two fold higher of microalbuminuria in smokers as compared to non-smokers. Other studies like these of Jensen JS et al 1994, Bigassi R et al 1999, Padrinelli Rs. 1997, Sprangles JG et al 1997 also showed increased prevalence of microalbuminuria in smokers among the study population.

CORRELATION BETWEEN MICROALBUMINURIA AND CAROTID INTIMA, MEDIA THICKNESS

Bignazzi R et al[43] 1995 showed that the presence of microalbuminuria in subjects of hypertension was associated with increased thickness of intima and media of the carotid arteries detected by 'B' mode ultrasound.

Pontremolli et al 1998[44] reported an increased intimal-medial carotid wall thickness (12.5±0.2mm) in microalbuminurics as compared to normal albuminurics (11.7±0.3mm).

Same observation has been made in Journal Association of Physicians India (JAPI) 2002.[14]

CORRELATION BETWEEN MICROLBUMINURIA AND SERUM URIC ACID

Bigazze R et al[13] 1995 showed that high levels of uric acid was found in the serum of microalbuminurics as compared to normal albuminurics.

This has also been shown by several other observers like Bianchi S (1999), Congo-Mbenza (1999), Hirai A (2000), Ruilope LM (2001).

CORRELATION OF MICROALBUMINURIA AND SERUM HOMOCYSTEINE

Hoogeveen EK, et al in 1998[59] in the Hoorn Study observed the relationship of microalbuminuria with serum homocysteine. They studied an

age, sex and glucose tolerance stratified random sample of 50 to 75 years old general Caucasian population (N=680). The urinary albumin to creatinine ratio was measure in an early morning spot urine sample. After adjusting for age, sex, glucose tolerance category, hypertension, dyslipidemia and smoking the odds ratio for total homocyteine increment was significant.They concluded that both hyperhomocysteinemia and protein intake are related to microalbuminuria independent of NIDDM and hypertension. Hyperhomocysteinemia may partly explain the link between microalbuminuria and increase risk of cardiovascular disease.

MATERIAL AND METHODS

The study was performed in Kilpauk Medical College, Chennai. Our idea was to perform a case control study. We decided to study 100 subjects, 50 cases and 50 controls. Our cases were selected from Medicine wards, Cardiology and Medicine OPD and ICCU. We studied 50 patients with at least one Myocardial Infarction in past 2 years. Controls were all healthy subjects who were selected based on the WHO (1969) definition of healthy subject, viz.

1. They had no evidence of any disease or infirmity.
2. They had a sense of physical, social and mental well being.
3. They could perform their routine work without physical limitation.

We matched these 50 Controls with the cases for age and they belonged to the same region as the cases with no overt symptoms of coronary artery disease and with a normal ECG.

The exclusion criteria were decided as follows.

1. Age <30 and > 60 years
2. Diabetes Mellitus
3. Hypertension JNC Grade II or above.
4. Congestive cardiac failure.
5. Renal Disease
6. Gross Albuminuria

7. Females taking oral contraceptives.

After the study population was designed we subjected them to a battery of investigations. Each individual was asked their history in details and subject to thorough clinical examination including General and System wise detailed examination. Also were done the following tests.

ECG,

ECHO cardiograph,

URINE albumin, sugar, ketone bodies.

BLOOD for Hemoglobin, TLC, DLC, ESR,

Urea, Creatinine,

Fasting and Postmeal bloodsugar,

Uric acid,

S. cholesterol

The methods for some of these tests are discussed in brief.

MICRO ALBUMINURIA

In this study, we estimated the presence of albumin excretion by an immunoturbidimetric test.

BASIS OF MICRAL TEST

Micral test is an immunoassay specific for albumin. The test strip consists of a series of reagent pads. A chromatographic process, through the wick fleece to the buffer fleece, draws urine where the sample is adjusted to alkaline pH. In the conjugate fleece, albumin in the urine binds to a soluble conjugate of albumin antibody and beta galactosidase. Excess antibodies then bind to immobilized albumin in the capture matrix and then is effectively removed from the sample, so that the albumin bound to antibody enzyme complex reaches the color substrate pad. The substrate is chlorophenol red galactoside, which turns red when beta galactosidase splits galactose. The intensity of color produced is proportional to the albumin concentration in urine. The color found after 5 minutes is compared with a reference chart on the container. There are 3 color blocks reflecting albumin concentration of 20,50, 100 mg/L. The Micral Test Strip has a sensitivity of 100% and specificity of 91%.

TEST COMPONENT

One test strip contains monoclonal antibodies against human albumin (lgG) labeled with colloidal gold 6gm. and fixed albumin 9.5 mg.

PROCEDURE

1. Immerse the test strip into the urine such that the fluid level is just between the two black bars, withdraw the test strip after 5 seconds and place it across the top of the urine vessels. While immersing

and withdrawing the test strip do not allow the test strip to touch the collection vessels.

2. After 1 minute compare the color of test pad above the inscription "Micral" with the color scale on the test strip vial level. If the color development is slightly uneven average color is relevant. Comparison of the colour with the colour scale is possible for another 5 minutes then the colour disintegrates.

DETECTION OF ALBUMIN CONCETRATION ABOVE 100 mg/24 hrs.

The urine sample in such cases can be diluted by mixing one part of urine with two parts of water, the original albumin concentration is then calculated by multiplying the result obtained by three.

SAMPLE MATERIAL

Albumin excretion is increased after physical activities. It is therefore recommended to use urine that has been produced at rest, that is first morning urine collected immediately after rising. The liquid intake must be in the normal range. If the urine analysis does not take place within 3 days, store the urine in refrigerator at temperature +2°c to +8°c. Urine that has been refrigerated (for max 2 week) must first be brought to at least +10°c.

URINE

ALBUMIN

Albumin in urine was detected by heat precipitation test in the study. Make the urine slightly acid to litmus by, adding dilute acetic acid drop by drop, then filter or centrifuge to make urine clear. Test tube is filled three quarters with the urine and heat the top centimeter or two to boiling. Protein present is coagulated and seen by comparing with the unboiled urine lower down the tube.

Acidification of urine is important, otherwise in alkaline urine large amount of urine protein after boiling remains uncoagulated and go undetected. Acidification is done with acetic acid (33 percent). It is a common practice to heat the clear urine before making it acidic. After boiling, add acetic acid even if precipitate appears or not. If precipitate is dissolved by adding acetic acid , it is phosphate, if not then it is protein.

SUGAR

Urine sugar was detected by Benedict's Quantitative test.

Reagent 1. Benedict's Quantitative solution:

Dissolve 200 gms of sodium citrate, 75 gms of anhydrous sodium carbonate and 125 gms of potassium thiocyanate in about 100 ml. of water. Pour this slowly, stirring continuously. Add 5 ml of 5 percent, potassium ferrocyanide solution and make upto a litre with distilled water.

Reagent 2, Sodium carbonate (anhydrous)

Technique: Pipette 25 ml of the Benedict's quantitative solution in to a 10 ml round bottomed flask or beaker and 3 to 4 gms of sodium carbonate. Few pieces of porcelain are introduced to reduce bumping. Reagent is boiling urine ran slowly from a burette, shaking well at intervals. A white precipitate is formed and the blue color gradually disappears. End point is reached as the blue color completely disappears.

Calculation: 0.05 gm of glucose reduced 25 ml of the alkaline copper solution. Hence:

Grams glucose per 100 ml urine

$$= \frac{0.05 \times 100 \times N}{\text{ml required for the titration}}$$

Where N= no. of times of urine was diluted.

KETONE BODIES

Ketone bodies in urine were detected by Nitroprusside (Rothera's test). Saturate about 5 ml of urine with solid ammonium sulphate and add a little sodium nitroprusside, either about 0.5 ml of a percent solution or a small quantity of the powdered solid. Mix and add about 0.5 ml of concentrated ammonia. A purple color is given by acetoacetic acid and acetone that is maximal in about 15 minutes. If the ammonia is layered on,

a simple ring is obtained at the junction of the liquids. The test for ketone bodies is said to be positive.

BLOOD GLUCOSE ESTIMATION

METHOD : In this study we used GOD/POD method for estimation of fasting and postprandial blood sugar.

PRINCIPLE : Glucose is oxidized by the enzyme Glucose Oxidase (GOD) to give D-Gluconic acid and hydrogen peroxide. Hydrogen peroxide in presence of enzyme Peroxidase (POD) oxidizes phenol which combines with 4 aminoantipyrine to produce a red colored quinonimine dye. The intensity of the color developed is proportional to glucose concentration in the sample.

$$\text{D-glucose} + H_2O + O_2 \xrightarrow{\text{GOD}} \text{D-gluconic acid} + H_2O_2$$

$$H_2O_2 + \text{4 Amonoantipyrine} + \text{Phenol} \xrightarrow{\text{POD}} \text{Red Quinonimine dye} + H_2$$

REAGENTS

1. Enzyme reagent

2. Buffer solution

3. Glucose standard 100 mg%

NORMAL VALUES

Fasting : 70-110 mg/dl – **Normal**

> 110-126 mg/dl- **Impaired fasting glucose**

> 126 mg/dl – **diabetes mellitus**

After 2 hours of injection of 75 gms glucose.

<140mg/dl-**Normal**

140 -200 mg/dl- **Impaired Glucose tolerance test**

>200 mg/dl- **diabetes mellitus**

SERUM CREATININE ESTIMATION

METHOD : In this study we used Jaffe's Alkaline Picrate method for estimation of serum creatinine.

PRINCIPLE: In alkaline medium picric acid reacts with creatinine and produces red coloured comples, whose absorbance is proportional to creatinine concentration. Non-creatinine chromogens are also measured by this test which faslsely elevates the cretinine concentration. To over come this sulphuric acid is added., and non-creatinine chromogen remains

unaffected. This absorbance difference measured accurate creatinine concentration.

REAGENTS

1. Picric acid reagent.
2. Sodium Hydroxide 2 N
3. Standard

NORMAL VALUE – 0.6 -1.2 mg/dl.

BLOOD UREA ESTIMATION

METHOD : In this study, we used DAM method (Diacetyl Monoxime) for the estimation of Blood urea nitrogen.

PRINCIPLES : Method is based on condensation of urea with DAM in an acidic medium. Urea reacts with hot DAM in an acidic medium to produce coloured complex. The color is intensified by using thiosemicarbazide and cadmium salt. The intensity of colour produced is proportional to urea concentration.

REAGENTS

1. Urea Reagent
2. DAM (Diacetyl monoxime)

3. Urea standard

EXPECTED VALUES

20-40mg% (10-20 mg urea nitrogen)

ESTIMATION OF SERUM URIC ACID

METHOD : In this study, we used uricase method for quantitative estimation of uric acid in serum.

PRINCIPLE

Uricase is a very specific enzyme acting on Uric Acid, end products being allantoin and hydrogen peroxide. Peroxidase is used to utilize hydrogen peroxide (proportional to uric acid concentration) to convert chromogens to coloured complex. The intensity of color produced is proportional to uric acid concentration and is measured photometrically at 546nm (530-570 nm or with green filter).

Uricase

Uric acid +O_2+H_2O ---------- allantion +CO_2+H_20_2

H_20_2 +4-aminoantipyrine Perioxidase

\+ ----------> Coloured complex

DCHBS

REAGENTS

1. Uric acid (folic pack)

   (Enzymes, chromogen)

2. Uric acid (Buffer)

3. Uric acid standard (6mg/dl)

NORMAL VALUES

Serum uricacid

Male – 4-8 . 5 mg/dl;(0.24 to 0.51 mmol/L)

Female – 2.7 to 7.3 mg/dl; (0.16 to 0.43 mmol/l)

SERUM CHOLESTEROL

(One step method of Wybenga and Pileggi)

PRINCIPLE

Cholesterol reacts with hot solution of ferric perchlorate, ethyl acetate and sulphuric acid (cholesterol reagent) and gives a lavender coloured complex, which is measured colorimetrically.

REAGENT

Reagent 1: Cholesterol reagent

Reagent 2: Working Cholesterol standard, 200mg%.

Auxillary : Normal saline

NORMAL VALUES

Varies with diet and age. Adult-150-250 mg./dl.

OBSERVATION

TABLE – 1

INCIDENCE OF MICROALBUMINURIA IN CASES AND CONTROLS

Total Population (N=100)	Microalbuminuria			
	Positive		Negative	
	Number	Percentage	Number	Percentage
Cases (n=50)	33	66%	17	34%
Controls (N=50)	10	20%	40	80%

TABLE – 2

DISTRIBUTION OF THE CASES ACCORDING TO AGE GROUPS AND IN RELATION TO MICROALBUMINURIA

Age groups	Microalbuminuria			
	Positive		Negative	
	Male	Female	Male	Female
30-35 (N=5)	1	-	4	-
36-40 (N=5)	4	-	-	1
41-45 (N=8)	5	-	1	2
46-50 (N=11)	7	1	-	3
51-55 (N=13)	4	5	-	4
56-50 (N=8)	4	2	-	2
Total (N=50)	(N=25)	(N=8)	(N=5)	(N=12)
Mean ± SD	48.76 ± 6.97			

The mean age group of microalbuminuria positive people among cases was 48.76 ± 6.97.

TABLE – 3

DISTRIBUTION OF THE CONTROLS ACCORDING TO AGE GROUPS AND IN RELATION TO MICRO ALBUMINURIA

Age groups	Microalbuminuria			
	Positive		Negative	
	Number	Percentage	Number	Percentage
30-35 (N=5)	-	-	5	-
36-40 (N=5)	-	-	4	1
41-45 (N=8)	-	-	6	2
46-50 (N=11)	2	-	5	4
51-55 (N=13)	3	-	1	9
56-50 (N=8)	3	2	1	2
Total (N=50)	(N=8)	(N=2)	(N=22)	(N=18)
Mean ± SD	54.5 ± 4.12			

The mean age group of microalbuminuria positive people among controls was 54.5 ± 4.12.

The mean age group difference noted among cases and controls showed that microalbuminuria was found in a lower age group (48.76 ± 6.97) in cases as compared to controls (54.5 ± 4.12). The difference was statistically significant. $Z=3.22$ $P < 0.05$.

TABLE 4

DISTRIBUTION OF THE CASES ACCORDING TO SEX AND IN RELATION TO MICRO ALBUMINURIA

Sex	Microalbuminuria	
	Positive	**Negative**
	Number (%)	**Number (%)**
Males N=30	25 (83.33%)	5 (16.66%)
Females N=20	8 (40%)	12 (60%)

Among cases males have higher incidence of microalbuminuria than females with statistical significance. $\chi^2 = 10.04$ $P < 0.05$.

TABLE – 5

DISTRIBUTION OF THE CONTROLS ACCORDING TO SEX AND IN RELATION TOM ICROALBUMINURIA

Sex	Microalbuminuria	
	Positive	**Negative**
	Number (%)	**Number (%)**
Males N=30	8 (36.36%)	22 (73.33%)
Females N=20	2 (10%)	18 (90%)

Among controls males have higher incidence of microalbuminuria than females but without statistical significance. $\chi^2 = 2.08$ $P > 0.05$.

TABLE – 6

DISTRIBUTION OF THE CASES ACCORDING TO SMOKING STATUS AND IN RELATION TO MIROALBUMINURIA

Smoking Status	Microalbuminuria	
	Positive	**Negative**
	Number (%)	**Number (%)**
Yes N=25	23 (92%)	2 (8%)
No N=25	10 (40%)	15 (60%)

Among cases smokers had higher incidence of microalbuminuria than non smokers. $\chi^2 = 15.06$ $P < 0.001$

TABLE – 7

DISTRIBUTION OF THE CONTROLS ACCORDING TO SMOKING STATUS AND IN RELATION TO MICRO ALBUMINURIA

Smoking Status	Microalbuminuria	
	Positive	**Negative**
	Number (%)	**Number (%)**
Yes N=18	8 (44.4%)	10 (55.5%)
No N=32	2 (6.25%)	30 (93.75%)

Among controls also smokers had higher incidence of microalbuminuria than non smokers. $\chi^2 = 10.05$ $P < 0.05$.

TABLE – 8

DISTRIBUTION OF THE CASES ACCORDING TO BODY MASS INDEX AND IN RELATION TO MICRO ALBUMINURIA

Body Mass Index	Microalbuminuria	
	Positive	Negative
	Number (%)	Number (%)
> 25	21 (80.76%)	5 (19.24%)
≤ 25	12 (50%)	12 (50%)

Among cases BMI > 25 was significantly associated with microalbuminuria with $\chi^2 = 5.27$ $P < 0.05$.

TABLE – 9

DISTRIBUTION OF THE CONTROLS ACCORDING TO BODY MASS INDEX AND IN RELATION TO MICROALBUMINURIA

Body mass index	Microalbuminuria	
	Positive	Negative
	Number (%)	Number (%)
> 25	5 (50%)	5 (50%)
≤ 25	5 (12.5%)	35 (87.5%)

Among controls also microalbuminuria was significantly associated with BMI > 25. $\chi^2 = 7.03$ $P < 0.05$.

TABLE – 10

DISTRIBUTION OF THE CASES ACCORDING TO TOTAL CHOLESTEROL AND IN RELATION TO MICROALBUMINURIA

Total cholesterol	Microalbuminuria	
	Positive	Negative
	Number (%)	Number (%)
> 200	22 (88%)	3 (12%)
≤ 200	11 (44%)	14 (56%)

Among cases Total Cholesterol > 200 was observed to correlate significantly with microalbuminuria $\chi^2 = 10.78$ $P < 0.001$.

TABLE – 11

DISTRIBUTION OF THE CONTROLS ACCORDING TO TOTAL CHOLESTEROL AND IN RELATION TO MICROALBUMINURIA

Total Cholesterol	Microalbuminuria	
	Positive	Negative
	Number (%)	Number (%)
> 200	2 (33.33%)	4 (66.67%)
≤ 200	8 (18.18%)	36 (81.81%)

But among controls Total Cholesterol > 200 did not correlate significantly with microalbuminuria $\chi 2 = 0.76$ $P > 0.05$.

TABLE – 12

DISTRIBUTION OF THE SMOKERS IN THE STUDY GROUP ACCORDING TO MICROALBUMINURIA

Microalbuminuria	Positive	Negative
	Number (%)	Number (%)
Positive (N=31)	23 (74.19%)	8 (25.80%)
Negative (N=12)	2 (16.66%)	10 (83.33%)

Total smokers = 43

Cases = 25

Controls = 18

Microalbuminuria positive people were more among cases than controls when the smokers of the study group were considered together. This was significant statistically also,

χ^2 = 11.76

$P < 0.05$.

TABLE – 13

ASSOCIATION OF BMI > 25 WITH MICROALBUMINURIA

Microalbuminuria	Positive	Negative
	Number (%)	Number (%)
Positive (N=26)	21 (80.76%)	5 (19.23%)
Negative (N=10)	5 (50%)	5 (50%)

Total smokers = 36

Cases = 26

Controls = 10

In the group with BMI > 25, Microalbuminuria positivity was seen more among cases than among controls. But $\chi 2 = 3.41$ P >0.05 makes it statistically insignificant. The 95% confidence Interval here has an upper limit 26.58 and lower limit 0.65.

TABLE – 14

ASSOCIATION OF TOTAL CHOLESTEROL > 200

WITH MICROALBUMINURIA

Microalbuminuria	**Positive**	**Negative**
	Number (%)	**Number (%)**
Positive (N=24)	22 (19.66%)	2 (8.33%)
Negative (N=7)	3 (42.85%)	4 (57.15%)

Total smokers = 31

Cases = 25

Controls = 6

Microalbuminuria was seen more in cases than controls.

χ^2 = 8.27

$P < 0.001$.

TABLE – 15

ASSOCIATION OF MICROALBUMINURIA WITH SEX, SMOKING STATUS, BMI, TOTAL CHOLESTEROL IN THE STUDY GROUP

	CASES (N=50) Microalbuminuria		CONTROLS (N=50) Microalbuminuria	
	Positive	Negative	Positive	Negative
Male	25	5	8	22
Female	8	12	2	18
Smoker	23	2	8	10
BMI > 25	21	5	5	5
Total cholesterol > 200	22	3	2	4

DISCUSSION

ASSOCIATION OF MICROALBUMINURIA WITH MYOCARDIAL INFARCTION

Out of the 50 cases present in this study microalbuminuria was found among 33, which was 66% while in controls this was only 10, which means 20%. This difference among cases and controls was significant statistically too, $X^2 = 21.58$ $P < 0.001$. This observation shows that microalbuminuria is associated significantly with Ischemic Heart Disease. The association of microalbuminuria with myocardial infarction has also been noted by Taskiran M et al.[55] in 1998.

CORRELATION BETWEEN MICROALBUMINURIA & AGE

The age group of the subjects in this study was ≥ 30 and ≤ 60. Among cases microalbuminuria was found in different age groups as shown in tables No.2 and 3, it is seen that the mean age group of microalbuminuria positive cases was 48.76 ± 6.97 and that for controls was 54.5 ≤ 4.12. This clearly shows that microalbuminuria is seen at a younger age group among cases and the difference is significant $Z = 3.22$ $P < 0.05$. The observation of presence of microalbuminuria at higher age group among controls goes along with different studies done by Bonet J et al.2001, Agarwal[39] B et al. 1996, Jensen JS et al. [33] 1997 which showed that microalbuminuria is associated with older age group.

CORRELATION OF MICROALBUMINURIA WITH SEX

We had 60 males (30 cases, 30 controls) and 40 females (20 cases, 20 controls) in the study group. As shown in Table No.4, among the cases 25 out of the 30 males had microalbuminuria while only 8 out of the 20 females had it. This shows that among cases males had higher incidence of microalbuminuria $X^2 = 10.04$ $P < 0.05$.

As per the Table No.5, among the controls only 8 out of 30 males had microalbuminuria and only 2 out of 20 females had the same. Even through males have a higher rate of microalbuminuria among controls the value is not statistically significant $X^2 = 2.08$ $P>0.05$. If we consider cases and controls together males are having more incidence of microalbuminuria with statistical significance $X^2 = 8.81$ $P < 0.05$. This observation is similar to the studies done by Gould MM et al., 1993, Mortin J et al. in 1996[41] and the Copenhagen study[33] that microalbuminuria is associated with male sex.

CORRELATION OF MICROALBUMINURIA WITH SMOKING

As evident from Table No.6, there were 25 smokers among the 50 cases, all being males. Among these 23 (92%) had microalbuminuria which was significant $\chi 2 = 15.06$ $P < 0.001$. Which shows that microalbuminuria is significantly associated with smokers with MI. We also had 18 smokers

among the controls of which 8 (44.4%) had microalbuminuria as shown in Table no.7. This shows that majority of the controls who showed microalbuminuria were smokers (8 out of 10).

We took the smokers in the study group together and found that (Table No.12) of the 43 smokers 25(58.13%) were cases and 18 (41.86%) were controls. This shows the increased risk of IHD among smokers. We also noticed that among smokers 31 were having microalbuminuria. Of the 31, majority 23 (74.19%) belonged to cases and 8 (25.80%) controls. This observation that among smokers microalbuminuria positivity was seen more among cases with statistical significance ($\chi 2 = 11.76$ $p < 0.001$) makes it obvious that microalbuminuria can be considered independent of smoking status for risk of IHD. This observation is similar to those made by Mimarn et al. 1997[24], Jensen et al.[49], Pedrinelli et al. [54].

CORRELATION OF MICROALBUMINURIA WITH BODY MASS INDEX

We classified the study group according to BMI > 25 or BMI ≤ 25. We found that among cases there were 26 with BMI > 25 as shown in Table No.8. Among these, microalbuminuria was seen in 21(80.76%) and 5 (19.24%) did not have it. This when analyzed was significant $\chi 2 = 5.27$ $P < 0.05$. This observation has gone along with those made by Bonet J et al. 2001, Donovan SJ et al 2000, Agarwall S et al. 1993, Mimran et al. 1996[24] that microalbuminuria is associated with high body mass index. When we

calculated the mean BMI for cases and controls we found that it was 24.16 ± 2.559 and 23.χ 6.68 Respectively. This difference between the BMI of cases and controls was not significant statistically.

We also observed as in Table No.9 that microalbuminuria was seen in 5 out of 10 controls who had BMI > 25 this was also significant statistically $\chi 2 = 7.03$ $P < 0.05$. This again shows association of microalbuminuria with high BMI.

As shown in Table No.13 we found that there were 36 people with BMI > 25 in the study group of this 26 (72.22%) were cases and 10 (27.77%) controls. This shown increased incidence of IHD in BMI > 25. We also observed that microalbuminuria was seen in 26 in the group, of which 21 were cases and 5 controls. This showed that microalbuminuria was seen more among the cases with BMI > 25 than among the controls with BMI > 25. But this when analyzed was not significant statistically $\chi^2 = 3.41$ $P > 0.05$. Since the χ^2 value is close to significant we apply the 95% confidence interval here. The 95% Cl in this cases has an upper limit 26.58 and a lower limit 0.65. It can be said that the chance of microalbuminuria positivity is more among cases at the high 26.58% and at the low 0.65% than the controls inspite of all having BMI > 25. This may show microalbuminuria to be an independent factor of IHD.

CORRELATION OF MICROALBUMINURIA WITH TOTAL CHOLESTEROL

We classified the study group according to total cholesterol > 200 and ≤ 200. As per the Table No.10 there were 25 cases with total cholesterol > 200, of these 22 (88%) were having microalbuminuria this was significant statistically also $\chi 2 = 10.78$ $P < 0.001$. We also had 6 controls as shown in Table no.11 with total cholesterol > 200, but only 2 (33.33%) of them had microalbuminuria, this was not significant $\chi^2 = 0.76$ $P > 0.05$. The association of microalbuminuria with lipid abnormalities has been reported by various research workers like Kim CH et al. [48]. Jensen JS [49] Mennen LI et al.[50] and also. The mean value of total cholesterol of cases was 188.54 ± 29.25 and for controls was 174 ± 17.90 the difference being significant statistically.

As seen in Table No.14 we grouped all the individuals with total cholesterol > 200 and found that there were 31 in total among those 25 (80.64%) were cases and 6 (19.36%) were controls. This shows the association of increased total cholesterol with IHD. We also observed that in this group microalbuminuria was seen in 24. Of this 22 (91.66%) belonged to cases and 2 (8.33) belong to controls this was statistically significant $\chi^2 = 8.27$ $P < 0.001$. This shows inspite of all having total cholesterol > 200, microalbuminuria was seen significantly among cases making it an independent marker.

MICROALBUMINURIA IN CONTROLS

In our study we observed that 10 persons out of 50 among the controls (20%) had microalbuminuria. Of these –

- 8 were males
- 2 were females
- 8 were smokers (all males)
- 5 had BMI> 25
- 2 had Total cholesterol > 200

This shows that the finding of microalbuminuria among controls could be explained by all the 8 males being smokers and the 2 females being of older age group (60 year old).This observation is similar to those made by Jensen JS et al. 1995[49]. Hillege et al. 2001[57]. This also warrants the need for follow up of these individuals further.

SUMMARY

In the present study we took 100 individuals, of these 50 were cases all of them had at least one myocardial infarction in last 2 years. We had 29 cases of Anterior wall MI, 19 cases of Inferior wall MI, 2 had both. Of the IWMI 2 had posterior wall involvement and 2 had right ventricle involvement. The other 50 were controls who were selected according to the WHO criteria for a healthy person. These individuals were investigated thoroughly in Kilpauk Medical College and Hospital, Chennai. Findings of the current study are as follows :

1. Microalbuminuria is associated with IHD. In our study out of the 50 cases 60% (N=33) had microalbuminuria while out of the controls only 20% (n=10) had microalbuminuria.
2. Microalbuminuria was seen at a younger age group (48.76 ± 4.12).
3. Male sex is associated with microalbuminuria. Among the 30 males in cases 25 (83.33%) had microalbuminuria.

   While among the 20 female cases only 8 (40%) had microalbuminuria.

   Among the 10 controls who had microalbuminuria 80% (n=8) were males.

4. Smoking status is associated with increased risk of IHD.

We had 50 cases of which 50% (n=25) were smokers. In our control group of 50, there were 36% (n=18) smokers.

5. Microalbuminuria is seen more among smokers.

   In cases who are smokers (n=25), microalbuminuria was present in 92% (n=23).In controls who are smokers (n=18) microalbuminuria was present in 44.4% (n=8).

6. Microalbuminuria is independently associated with IHD, irrespective of smoking.

   Out of the 43 smokers, 31 had microalbuminuria. Among these majority 74.19% (n=23) were cases and only 25.80% (n=8) were controls.

7. Higher BMI carries risk for IHD. In this study the BMI for cases was higher (24.16 ± 2.559) than that of controls (23 ± 6.68). Also of the total 36 with BMI more than 25 there were 26 cases.

8. Microalbuminuria is associated with high BMI.

   In cases, 26 had a BMI > 25 of these 80.76% (n=21) had microalbuminuria while in controls, 10 had a BMI > 25 of these 50% (n=5) had microalbuminuria.

9. Microalbuminuria is associated with IHD irrespective of BMI.

We had 36 people with BMI > 25 of these 72.22% (n=26) fall among cases and only 27.77% 9n=10) were controls. There were 26 people with microalbuminuria and BMI > 25. Of these 80.76% (n=21) were among cases and only 19.23% (n=5) among controls.

10. High total cholesterol is a risk factor for IHD.

In the present study the total cholesterol value was 188.54 ± 29.25 in cases and was 174 ± 17.90 for controls.

11. Microalbuminuria is associated with high cholesterol in IHD.

Among cases there were 25 with total cholesterol > 200 of this 88% (n=22) had microalbuminuria. Among controls 6 had total cholesterol > 200 but only 33.33% (n=2) had microalbuminuria.

12. Microalbuminuria is seen independently in IHD irrespective of total cholesterol.

We had 31 people with total cholesterol > 200. We found that 24 of these had microalbuminuria. Of these 91.66% (n=22) were cases and only 8.33% (n=2) were controls.

CONCLUSION

The conclusions draw from the present study are as follows :

1. The incidence of microalbuminuria in nondiabetic Myocardial infarction was 66%.
2. Microalbuminuria is seen at a younger age group in MI.
3. Microalbuminuria is associated with male sex significantly.
4. Microalbuminuria is strongly associated with smoking.
5. Smoking carriers a high risk for IHD.
6. High Body Mass Index is associated with MI.
7. Microalbuminuria is strongly associated with high Body Mass Index.
8. Total cholesterol is significantly higher in MI.
9. Microalbuminuria is strongly associated with high total cholesterol.
10. Microalbuminuria is seen independent of smoking status, BMI, total cholesterol in patients of MI.
11. Microalbuminuria is seen in older age groups and among smokers in normal subjects.

BIBLIOGRAPHY

1. Yudkin JS, Forrest RD, and Jackson C. Microalbuminuria as a predictor of vascular disease in non diabetic subjects. Lancet 1988. 11 : 530-33.
2. Microalbuminuria is independently associated with ischemic electrocardiographic abnormalities in large non-diabetic population. PREVEND (Prevention of Renal and Vascular Endstage Disease) TRIAL. European Heart Journal 2000, 21 : 1922-27.
3. Gerstein HC, Mann JF, Pongue J, Yusuf S. Prevalence and determinants of microalbuminuria in high risk diabetic and non diabetic patients in HOPE study. Diabetes Care 2000 April, 23 : 35-39. Suppl B.
4. Felat – Rasmussen B, Nephrological Department, Rigs Hospital, Copenhagen, Denmark. Microalbuminuria, endothelial dysfunction and cardiovascular risk. Diabetes M etab 2000 July, 26 Suppl. 4 : 64-6.
5. Gosling P. Microalbuminuria a marker of systemic disease. British Journal of Hospital medicine, 1995, 54 : 285-90.
6. Damsgaard EM, Froland A, Jorgensen OD, Mongensen CE, Microalbuminuria as a predictor of increased mortality in elderly people. British Medical Journal 1990, 300 : 297-300.
7. Bright R. Cases and Observation illustrative of renal disease accompanied with the secretion of albuminous urine. Guy’s Hosptial Report, 1836 : 10-338-400.

8. Kimmelsteil P, Wilson C. Intercapillary lesions in the glomeruli in the kidney. AM J Pathology, 1936, 12 : 83-97.
9. Stehouwer CD, Naceta JJ, Zeldeurest GC, Donker AJ, Ottolander GJ, Urinary albumin excretion, cardiovascular disease and endothelial dysfunction in NIDDM. Lancet 1992, 3 : 340 : 319-23.
10. Mongenson CE, Christensed CK. Predicting diabetic nephropathy in IDDM. New England Journal of Medicine, 1984-311 : 89.
11. Yip J. Mattok MB, Morocutti A, Sethi M, Treviasa R. Insulin REsistance in IDDM with microalbuminuria. Lancet 1993, 342, 883-87.
12. Mimarn A, Microalbuminuria in essential hypertension. Clini Exp Hypertension 1997, 19 : 753-67.
13. Bigazzi R, Bianchi S. Microalbuminuria as a marker of cardiovascular and renal disease in essential hypertension Nephrology Dialysis Transplant 1995, 10 (suppl 6) : 10-14.
14. Microalbuminuria is associated with carotid intimal medial thickening and coronary Artery disease in Diabetics, JAPI 2002, 50 : 1124-1129.
15. Cummings MH,Watts GF, Tavakolian A, Fitzgerald A. Prevalence of micro albuminuria, lipoprotein(a), and coronary artery disease in the lipid clinic. Journal Clinic Pathology 1996 Jan, 49(1) : 19-23.
16. Viberti GC, Mackintosh D, Bilous RW, Keen H. Proteinuria in diabetes mellitus, role of spontaneous and experiemental variation. Kidney 1982; 21 : 714-20.

17. Mongensen CE, Microalbuminuria predicts clinical proteinuria and early mortality in maturity onset diabetes. NEJM 310 : 356-360, 1984.

18. Jarrett RJ, Viberti GC, Mahmud U. Microalbuminuria predicts mortality in NIDDM. Diabetic Med. 1984; 1 : 17-19.

19. Winocour PH, Harland JOE, Miller JP, Laker MF : Microalbuminuria and associated cardiovascular risk factors in the community.Atherosclerois 1992 : 93 : 71-81.

20. Deekert T, Feldt : Rasmussen B, Bore Johnsen K. Jensen T, Kofoed Enevolsen A : Microalbuminuria reflects widespread vascular damage. The Steno Hypothesis in Diabetalogia 1989; 32 : 219-226.

21. Stehouwer CDA, Nauta JJP, Zeldenhurst GC : Urinary albumin, cardiovascular disease and endothelial dysfunction. Lancet 1992; 340 : 329-323.

22. Coller A, Rumley AG, Leach JP, Lowc GDO, Small M : Free radical activity and hemostatic factors in NIDDM patients with and without Microalbuminuria. Diabetes 1992; 41 : 909-13.

23. Redon J et al : Ambulatory blood pressure and MAL in essential hypertension. J. Hypertension 1994 Aug 12 (8) : 947-53.

24. Mimarm A ; Miicroalbuminuria in essential hypertension. Clin. Exp. Hypertension 1997; 19 : 753-67.

25. Cirillo M, Stellato D, Laurnzi M. Panarrelli W, Zanchetti A, De Santo NG : Pulse pressure and isolated systolic hypertension : Association with microalbuminuria. The GUBBIO study Collaboration Research Group. Kidney Int. 2000 Sep : 58 (5) : 1211-8.

26. Jensen JS. Microalbuminuria and the risk of atherosclerosis clinical epidemiological and physiological investigations. Dan Med. Bull. 2000 April, 47 (2) : 63-78.

27. Reaven GM : Role of insulin resistance in human disease – diabetes 1988 ; 37 : 1495-1507.

28. Niskansen L, Laakso M : Insulin resistance is related to albuminuria with type-II diabetes mellitus. Metabolism 1993; 42 : 1541-1545.

29. Forsblom CM, Encksson JG, Teppo AM, Group LC, Ekstrand VA : Insulin resistance and abnormal albumin excretion in non-diabetic first degree relatives of patients with NIDDM Diabetologia 1995; 36 : 363-369.

30. Festa A, D'Agortino R, Howard G, Mykkanen L, Haffner SM : Inflammation and Microalbuminuria in non-diabetic and NIDDM subjects : The Insulin Resistance Atherosclerosis Study Kidney Int. 2000 Oct. 9 : 58(4) 1703-1710.

31. Jensen JS, Foldt – Rasmussen B, Strandgard S, Schroll M, Borch Johnsen : Arterial Hypertension, Microalbuminuria and risk of IHD. Hypertension 2000 April; 35 (4) : 898-903.

32. Lisowska – Myjak B : Microalbuminuria as a prognostic marker of cardiovascular diseases. Article in Polish Pol Merkuriusz Lek 1997 July (13) : 28-29.

33. Jensen JS, Feldt – Rasmussen B, Borch Johnson K, Clausen P, : Microalbuminuria and its relation to cardiovascular disease and risk factors : A population based study of 1254 hypertensive individuals. J. Hum Hypertension 1997, Nov. 11 : 727-32.

34. Prevalence and determinants of microalbuminuria in high-risk diabetic and non-diabetic patients in the HOPE study.Gerstein HC, Mann JF, Pogue J. Dinnen SF, Halle JP, Joyce C, Voung J. Mc Master University, Mailton, Ontario, Canada Gerstein @ fhs. csu.mcmaster.ca.

35. Diercks GF, Janseen WM, Von Boven AJ, Bak AA, De Jong PE, Van Gilst WH. Rationale, design and baseline characteristics of a trial of prevention of cardiovascular and renal disease with fosinopril and pravastatin in non-hypertensive, non-hypercholestrolemic subjects with microalbuminuria (The Prevention of Renal and Vascular Endstage Intervention Trial) Am. J. Cardiology 2000 Sept. 15; 86(6) : 635-638.

36. Microalbuminuria potential marker for increased cardiovascular risk factors in non-diabetic subjects? Haffner SM, Stern MP, Gruber MK, Hazuda HP, Mitchell BD. Department of Medicine, Unviersity of Texas Health Science Centre, San Antonio, 78284.

37. Taskiran M, Rasmussen B,Jensen GB, Jensen JS : Urinary albumin excretion in hospitalized patients with myocardial infarction. Prevalence of microalbuminuria and correlation to left ventricle wall thickness. Scandinavian cardio vascular Journal 1998 : 32(3) : 163-6.

38. Agarwal S, Wikstrand J. Ljungman S, Herlitz H, Fagarberg B : Does microalbuminuria predict cardiovascular events in non-diabetic men with hypertension. : The Risk Factor Intervention Study Group. Am. J. Hypertension 1995 April : 8, 337-42.

39. Agarwal B, Berger A, Wolf K. Luft FC : Microalbuminuria screening by reagent strip predicts cardiovascular risk in hypertension 23 : J. Hypertension, 1996 Feb. 14(2) : 223-8.

40. Predictors of cardiovascular and all-cause mortality, especially among hypertensive subjects; five year follow-up of Hoorn Study. Jager A, Kostence P J, Ruke HG, Heine RJ, Nijpels G, Dekker JM, Bouter LM, Stehouwer CD.

41. Viberti G, Martin J, Jose W. Mersent P J in diabetic nephropathy; Josslins Diabetes Mellitus New Delhi : B1 Waverly Pvt. Ltd. 13th edition 1996; 696-97.

42. Alzaid AA, Microalbuminuria in NIDDM population : an overview in Diabetes Vol. 19, 1996; (1) 79-89.

43. Bignazzi R, Bianchi S. Nenci R, Baldari D, Compere VM : Increased thickness of the carotid artery in patients with essential hypertension and microalbuminuria.

44. Pontremolli R, Viazzi F, Ruello N, Deferrari G, Microalbuminuria – a marker of cardiovascular and organ damage. Kidney Int. Suppl. 1998 Dec; 63 : 163-5.

45. Conquering the epidemic of coronary artery disease among Indians : crucial role of cardiologists : Enas A Enas, A Senthil Kumar. Quarterly Journal of Cardiology : 2002:1.

46. Will there be an epidemic of cardiovascular diseases in the developing countries? K. Srinath Reddy. Quarterly Journal of Cardiology : 2002:1.

47. Evidence of impaired glomerular charge selectivity in nondiabetic subjects with microalbuminuria: relevance to cardiovascular disease.

Kofoed –Enevoldsen A, Foyle WJ, Fernandez M, Yudkin JS.

Arterioscler Thromb Vasc Biol, 1996 Mar, 16(3) : 450-4.

Steno Diabetes Centre, Gentofte, Denmark.

48. Association of microalbuminuria and atherosclerotic risk factors in non-diabetic subjects in Korea.

Kim CH, Kim, Park JY, Park HS, Hong SK, Park SW, Lee KU.

Diabetes Res Clin. Pract. 1998 Jun: 40(3) : 191-9.

49. Atherosclerotic risk factors are increased in clinically healthy subjects with microalbuminuria. JensenJ S, Borch-Johnsen K, Jensen G, Feldt-Rasmussen B. Atherosclerosis, 1995 Jan. 20; 112(2) : 245-52.

50. Microalbuminuria and markers of the atherosclerotic process : te D.E.S.I.R. Study.

Mennen LI, Blakau B, Royer B, Caradec A, Marre M, Balkau B, E, Althen Gelas F, Bechetoille A, GalloisY, GIrault A, Marre M. Chesnier MC.

51. Microalbuminuria reflects as generalized transvascular albumin leakiness in clinically healthy subjects.

Jensen JS, Borch-Johnsen K, Jensen G, Feldi-Rasmussen B.

52. The importance of microalbuminuria as a cardiovascular risk indicator : A review.

Diercks GF, van Boven AJ, Hillege JL, de Jong PE, Rouleau JL, van Gilst WH. Can J Cardiol, 2002 May; 18(5) : 525-35.

53. Microalbuminuria : marker of vascular dysfunction, risk factor for cardiovascular disease. Garg JP, Bakris GL. Vasc Med. 2002 Feb; 7(1) : 35-43.

54. Non-diabetic microalbuminuria, endothelial dysfunction and cardiovascular disease. Pedrinelli R, Dell' Omo G, Penno G, Mariani M. Vasc Med. 2001 Nov. 6(4) : 257-64.

55. Urinary albumin excretion in hospitalized patients with acute myocardial infarction. Prevalence of microalbuminuria and correlation to left ventricle wall thickness. Taskiran M, Feldt-Rasmussen B, Jensen GB, Jensen JS. Scand Cardiovasc J. 1998; 32(3) : 163-6.

56. Microalbuminuria in nondiabetic adults; relation of blood pressure, body mass index, plasma cholesterol levels, and smoking : The Gubbio Population Study. Cirillo M, Seningalliesi L, Laurenzi M, Alfieri R, Stamler J. Stamler R, Panarelli W, De Santo NG. Arch Intern Med. 1998 Sep. 2

57. Microalbuminuria is common, also in a nondiabetic, nonhypertensive population, and an independent indicator of cardiovascular risk factors and cardiovascular morbidity.

Hillege HL, JansseN WM, Bak AA, Diercks FG, Grobee DE, Crijns JH, Van Gilst WH, de Zeeuw D, De Jong PE; The Prevent Study Group. J Intern Med. 2001 Jun; 249(6) : 519-26.

58. Microalbuminuria as predictor of vascular disease in non-diabetic subjects. Islington Diabetes Survey. Yudkin JS, Forrest RD, Jackson CA. Lancet, 1988 Sep. 3 : 2 (8610) : 530-3.

59. Serum homocysteine level and protein intake are related to risk of microalbuminuria : the Hoorn Study.

Hoogeveen EK, Kostense PJ, Jager A, Heine RJ, Jakobs C, Bouter LM, Donker AJ, Stehouwer CD. Kidney Int. 1998 Jul 54(1) : 203-9.

PROFORMA

Case Number

Name Age/Sex

Ward/Bed

Date of Admission

Address

Presenting complaints

History of Presenting complaints

Past History

1. History of angina

   If yes NYHA grade.

2. History of previous Myocardial infarction

   If yes when

3. History of Hypertension
4. History of claudications
5. History of stroke
6. History of any renal disease

Drug History

Personal History

Smoking Tobacco Cigarette Beedi

Alcoholism

Any other addiction

Diet

Bowel/Bladder/Sleep/Appetite

Obstetric and Menstural History

Socio-economic history

Level of education

Occupation

Family structure

Physical Examination

General examination

Built & Nourishment

Consciousness & Orientation

Height Weight

Pallor Icterus Cyanosis

Clubbing Oedema Lymphnodes

JVP Temp. Pulse

B.P. R.R.

SYSTEMIC EXAMINATION

1. Cardiovascular System

Inspection - Precordium

- Apex beat
- Visible Pulsation

Palpation - Apex beat

- Parasternal impulse
- Thrills

Percussion -

Auscultation S1 S2 S3 S4

Advertitious sounds

Murmur

2. Reparatory system
3. Per abdomen
4. CNS

INVESTIGATIONS

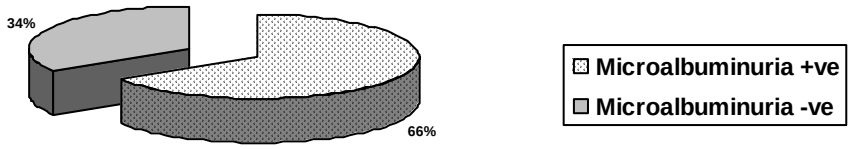
1. Complete Blood Picture - H TLC DLC ESR
   - TRBC Platelet count
2. Blood sugar - Fasting
   - Post meal
3. Blood urea
4. Serum creatinine
5. Serum uric acid
6. Serum total cholesterol
7. Microalbuminuria
8. Urine-Sugar Albumin Ketone Microscopy
9. X-ray chest PA view
10. ECG
11. Echo

ABBREVIATIONS

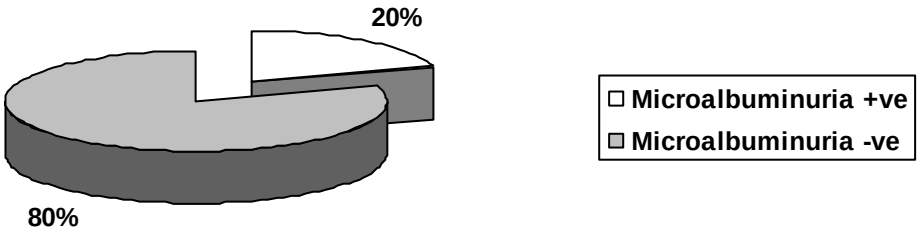
Apo-A	Apolipoprotein –A
BP	Blood Pressure
BMI	Body Mass Index
CAD	Coronary Artery Disease
CHD	Coronary Heart Disease
CRP	C-Reactive Protein
DM	Diabetes Mellitus
DAM	Di acetyl monoxime
EF	Ejection Fraction
F	Female
GOD	Glucose Oxidase
Hb	Hemoglobin
HDL	High Density Lipoprotein
HTN	Hypertension
Ht	Height
IDDM	Insulin Dependant Diabetes Mellitus
IgG	Immunoglobulin G
IHD	Ischemic Heart Disease
IPD	In Patient Department
IRAS	Insulin REsistance Atherosclerosis Study
LVH	Left Ventricular Hypertrophy
M	Male
MAL	Microalbuminuria

MAU	Microalbuminuria
NIDDM	Non Insulin Dependant Diabetes Mellitus
OPD	Out Patient Department
PAD	Peripheral Artery Disease
POD	Peroxidase
PR	Pulse Rate
R/M	Routine / Microscopy
Tch	Total Cholesterol
WHO	World Health Organization
Wt	Weight

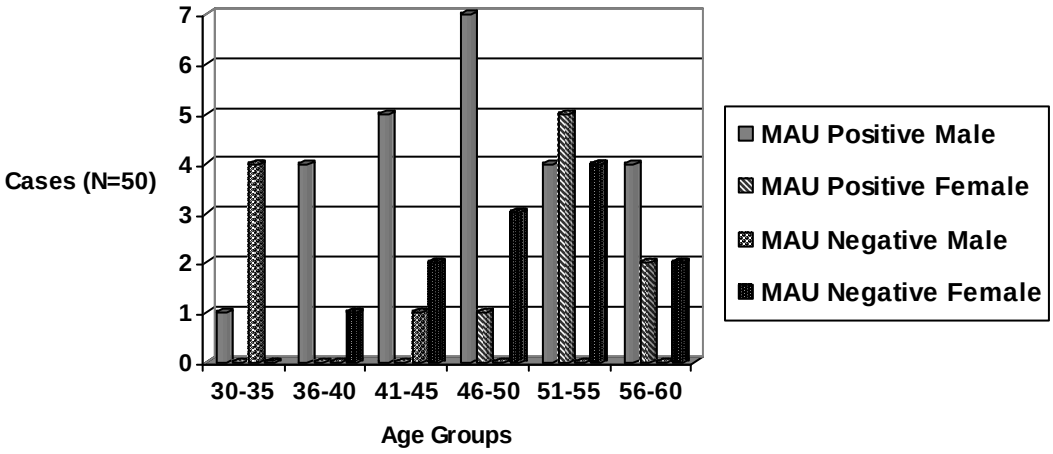
INCIDENCE OF MICROALBUMINURIA IN CASES



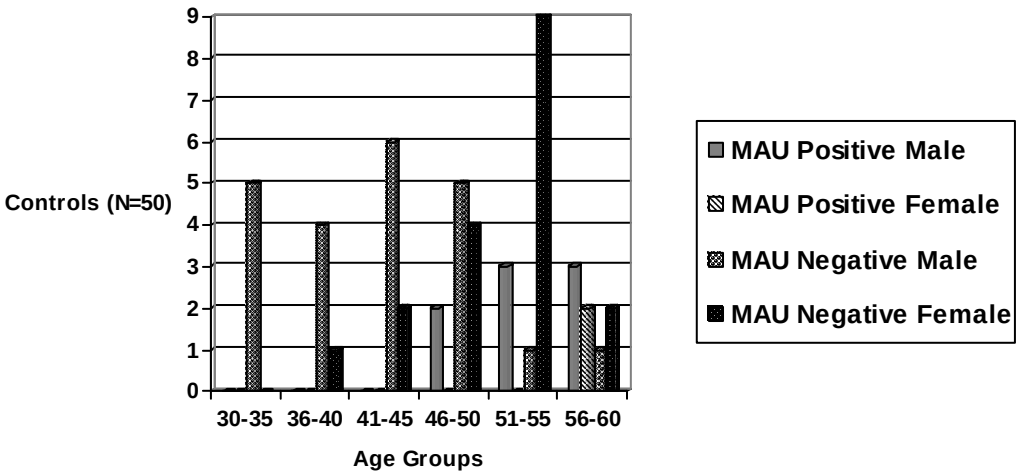
INCIDENCE OF MICROALBUMINURIA IN CONTROLS



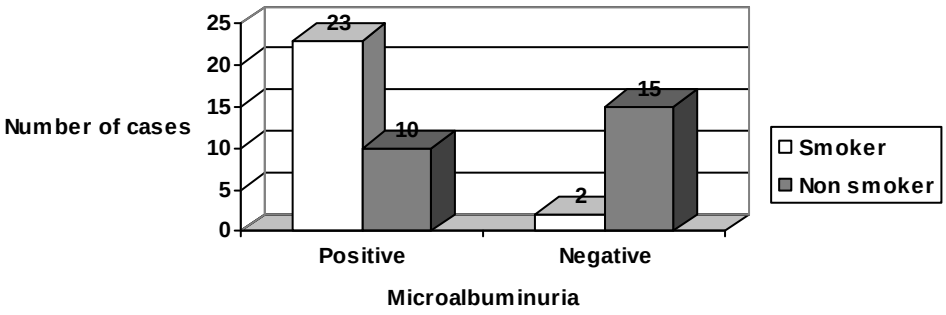
DISTRIBUTION OF THE CASES ACCORDING TO AGE,SEX AND MICROALBUMINRIA



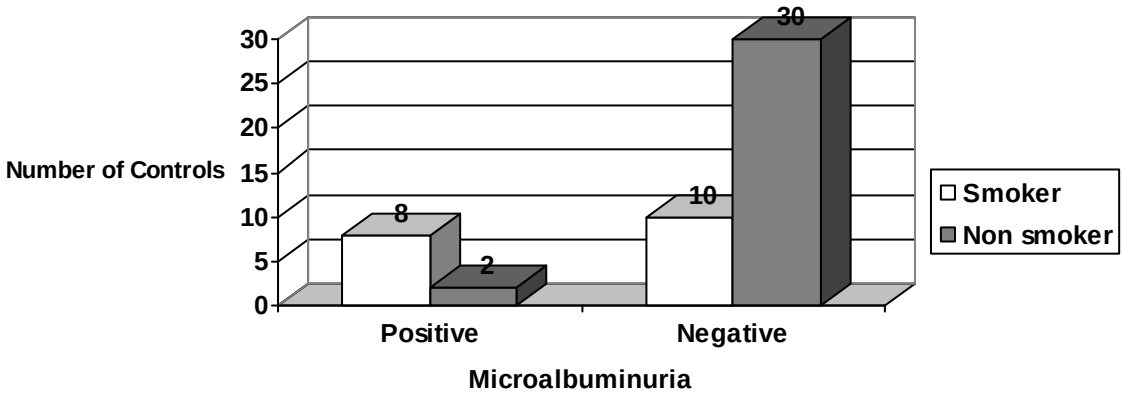
DISTRIBUTION OF THE CONTROLS ACCORDING TO AGE,SEX AND MICROALBUMINRIA



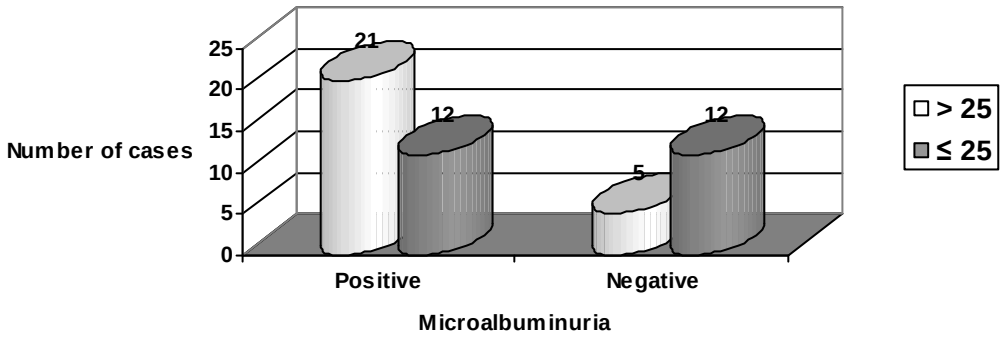
DISTRIBUTION OF SMOKING STATUS AND MICROALBUMINURIA IN CASES



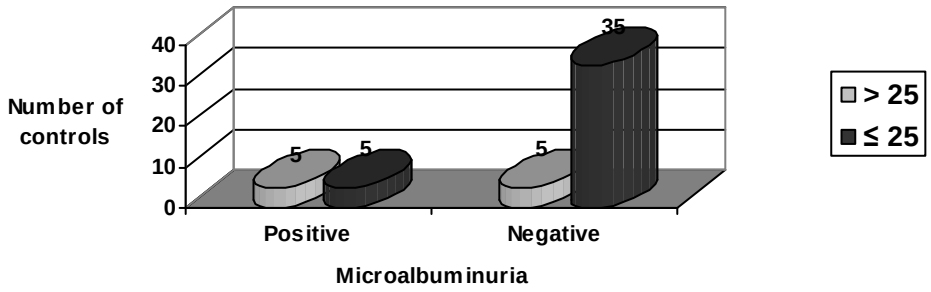
DISTRIBUTION OF SMOKING STATUS AND MICROALBUMINURIA IN CONTROLS



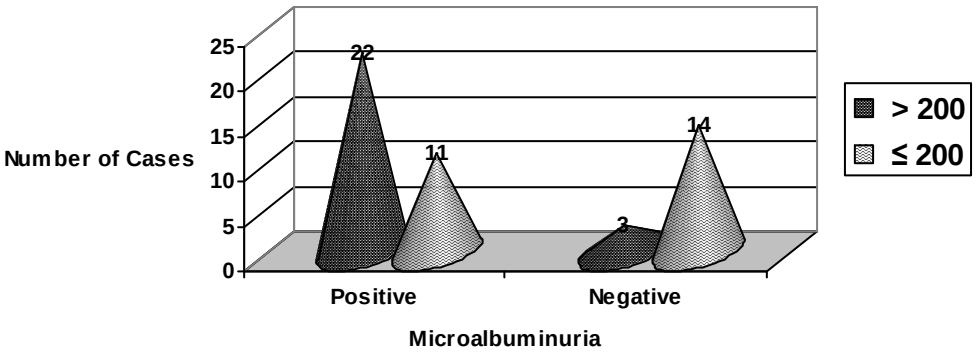
DISTRIBUTION OF CASES ACCORDING TO B.M.I & MICROALBUMINURIA



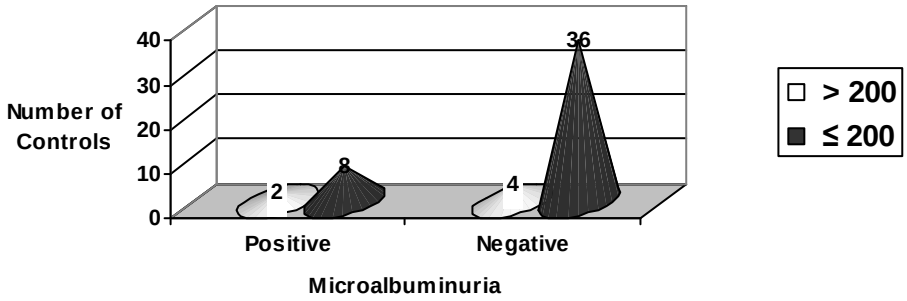
DISTRIBUTION OF CONTROLS ACCORDING TO B.M.I & MICROALBUMINURIA



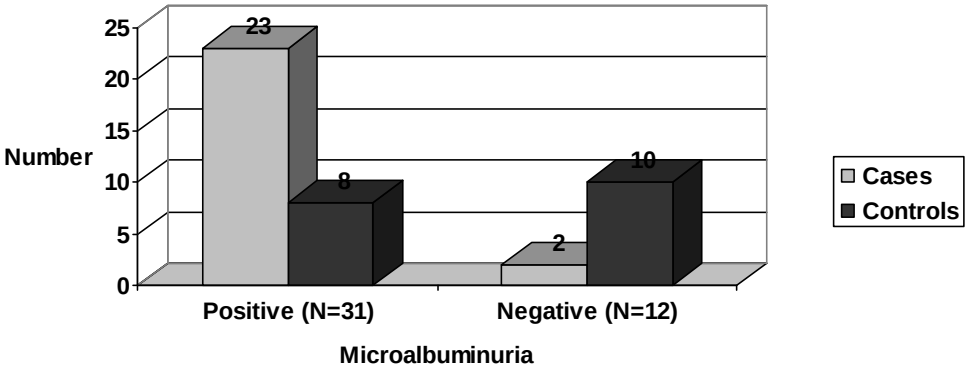
DISTRIBUTION OF CASES ACCORDING TO TOTAL CHOLESTEROL & IN RELATION TO MICROALBUMINURIA



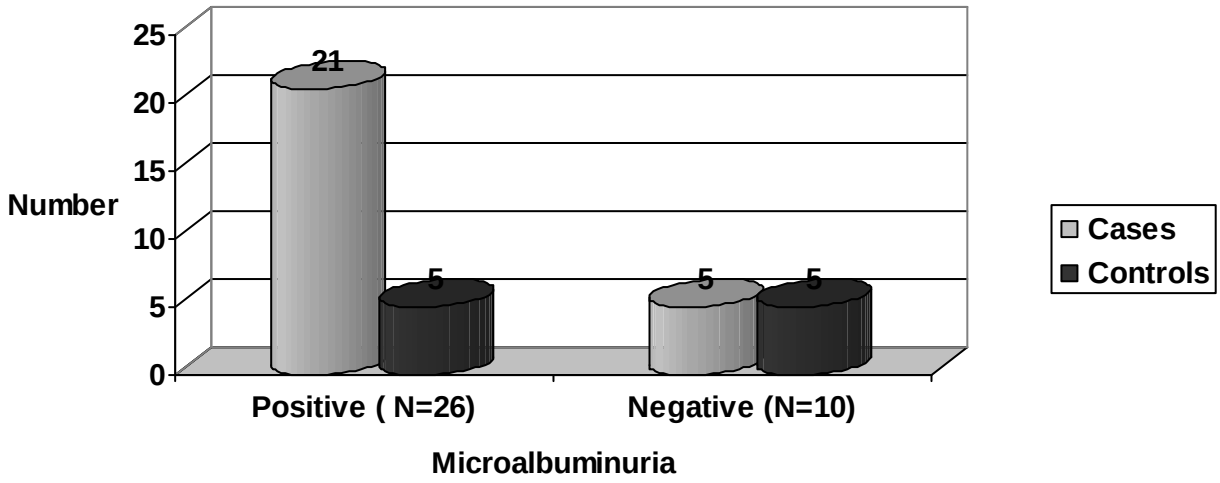
DISTRIBUTION OF CONTROLS ACCORDING TO TOTAL CHOLESTEROL & IN RELATION TO MICROALBUMINURIA



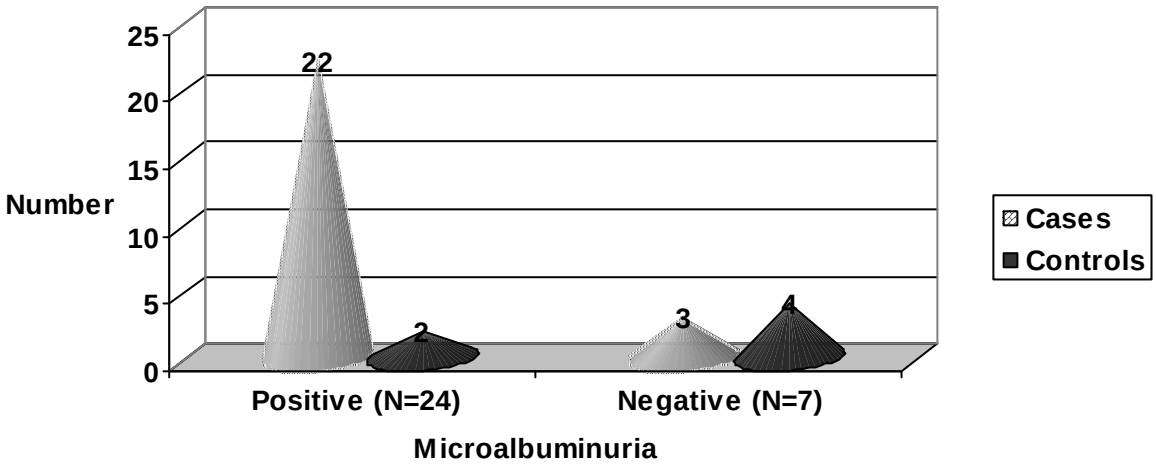
DISTRIBUTION OF SMOKERS IN THE STUDY GROUP ACCORDING TO MICROALBUMINURIA



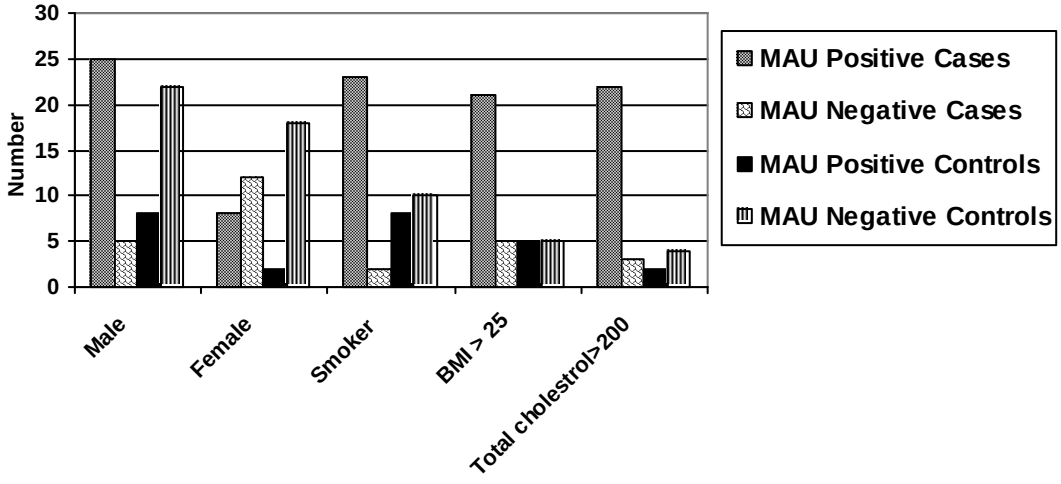
ASSOCIATION OF BMI >25 WITH MICROALBUMINURIA



ASSOCIATION OF TOTAL CHOLESTROL >200 WITH MICROALBUMINURIA



ASSOCIATION OF MICROALBUMINURIA WITH SEX,SMOKING STATUS, BMI AND TOTAL CHOLESTROL IN STUDY GROUP



MASTER CHART CASES

No.	Age	Sex	Pulse	Bp(mmHg)	B.M.L	Diagnosis	smoking	Total Cholestrol	Microalbuminuria	ECG Changes	ECHO
1	30	M	84/min	110/70	25.8	ASMI	- ve	203	+ ve	q V1-V6, ST ↑ V1-V6 T ↓	Akinetic AW & septum EF 74.8%
2	32	M	78/min	120/74	26.04	ASMI	+	183	- ve	ST ↑ T ↑ V1-V6, reciprocal in II, III avF	Akinetic AW & septum EF 65 % Apical aneurysm
3	35	M	66/min	100/68	21.48	ASMI	- ve	211	- ve	q V1-V6, ST↑ V1-V6 T ↓	
4	35	M	88/min	120/80	25.9	ASMI	- ve	188	- ve	ST ↑ T ↑ V1-V6	Akinetic AW & septum EF 43.63 %
5	35	M	77/min	84 systolic	20.1	ASMI	+	206	- ve	q V1-V4, ST ↑	Akinetic AW & septum EF 58 %
6	37	M	86/min	114/74	19.53	ASMI	+	130	+ ve	ST ↑T↑ V1-V6 , reciprocal in II,III avF	Hypokinetic AW & septum poor LV function
7	39	M	74/min	124/80	25.28	ASMI	+	160	+ ve	ST ↑ T ↑ V1-V6	Akinetic AW & septum EF 65.6 %
8	40	M	68/min	106/76	25.95	ASMI	+	234	+ ve	q V1-V6, ST ↑ V1-V6 T ↓	Akinetic AW, apex & septum EF 65.6 %
9	40	M	82/min	96 systolic	26.29	ASMI	+	170	+ ve	q V1-V6, ST ↑ V1-V6 T ↓	Hypokinetic AW & septum EF 65 %
10	41	M	54/min	90/70	26.44	IWMI	+	213	- ve	ST ↑ II, III avF T↑	Hypokinetic Iw
11	42	M	68/min	84/60	26.56	ASMI	- ve	150	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 43.63 %
12	42	M	56/min	80 systolic	26.39	AWMI with IWMI	+	232	+ ve	q V1-V6, ST ↑ II, III avF	Akinetic AW, IW & septum EF 40 %
13	43	M	48/min	120/70	23.87	IWMI	+	207.4	+ ve	ST ↑ II, III avF	Hypokinetic IW EF 53 %
14	45	M	82/min	130/84	27.54	ASMI	+	160	+ ve	ST ↑ T ↑ V1-V6	
15	45	M	75/min	116/76	26.29	ASMI	+	211	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 52 %
16	46	M	71/min	110/70	24.91	ASMI	+	225	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 50 %
17	48	M	68/min	90/70	24.5	IWMI	+	185	+ ve	ST ↑ II, III avF	Hypkinetic IW EF 60.9%
18	48	M	52/min	100/70	27.2	IWMI	+	157	+ ve	ST ↑ II, III avF T↑	Hypokinetic IW EF 38.6 %
19	50	M	68/min	120/82	23	AWMI	+	206.2	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & Septum EF 46 %
20	50	M	74/min	90 systolic	26.5	IWMI with PWMI	+	203	+ ve	ST ↑ II, III avF T↑ V1	Hypokinetic IW, PW, EF 41 %
21	50	M	52/min	100/70	23.5	IWMI with PWMI	+	156.7	+ ve	ST ↑ II, III avF T↑ V1	Hypokinetic IW, PW
22	50	M	54/min	120/64	21	IWMI	+	163	+ ve	ST ↑ II, III avF	Hypokinetic IW, EF 39.7 %
23	52	M	60/min	114/74	28.4	IWMI	+	201	+ ve	ST ↑ II, III avF T↑	Hypokinetic IW EF 72.8 %
24	54	M	70/min	134/84	21.5	ASMI	- ve	203	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 62 %
25	55	M	74/min	116/66	22.5	ASMI	+	206	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum
26	55	M	72/min	96/70	22.3	IWMI with PWMI	+	184	+ ve	ST ↑ II, III avF T↑ V1	Hypokinetic IW , PW
27	58	M	74/min	100/80	26.8	ASMI	+	134	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Hypokinetic AW & septum EF 44 %
28	58	M	76/min	104/68	25.6	OLD AWMI with	+	216	+ ve	q V1-V6, ST ↑ II, III avF	Akinetic AW & septum EF 40 %
29	58	M	58/min	110/70	23.8	IWMI	+	245	+ ve	ST ↑ II, III avF	Hypokinetic IW, aortic dilatation EF 42.8 %
30	60	F	56/min	120/74	27.4	IWMI	+	165	- ve	ST ↑ II, III avF	Hypokinetic IW EF 65 %
31	40	F	68/min	124/80	22	ASMI	- ve	135	NEG	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 58 %
32	43	F	72/min	80 systolic	23	RVMI	- ve	194	NEG	ST ↑ V1, V4R	Hypokinetic RV, EF 40 %
33	45	F	74/min	120/68	26	ASMI	- ve	195	NEG	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 74.68 %
34	48	F	76/min	110/74	20.4	ASMI	- ve	138	NEG	ST ↑ T ↑ V1-V6, reciprocal in II, III avF	Akinetic AW & septum EF 62 %
35	50	F	82/min	120/80	19.6	IWMI	- ve	184	NEG	ST ↑ II, III avF T↑	Hypokinetic IW EF 68.3 %
36	50	F	84/min	126/76	20.3	AWMI	- ve	137	NEG	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 54 %
37	50	F	86/min	112/72	26.3	AWMI	- ve	228.8	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 61.4 %
38	55	F	62/min	96/64	21	IWMI	- ve	148.5	NEG	ST ↑ II, III avF T↑	Hypokinetic IW EF 52 %
39	55	F	64/min	120/74	25.1	ASMI	- ve	212.6	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 58 % diastolic dysfunction
40	55	F	74/min	100/64	20.4	ASMI	- ve	205	NEG	ST ↑ T ↑ V1-V6, reciprocal in II, III avF	Hypokinetic AW & septum poor LV function EF 43 %
41	55	F	82/min	120/80	25.2	IWMI	- ve	183	NEG	ST ↑ II, III avF T↑	Hypokinetic IW EF 56.5%
42	55	F	86/min	110/86	20.6	ASMI	- ve	205	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 63.5 %
43	55	F	72/min	74 systolic	25.8	RVMI WITH IWMI	- ve	208	+ ve	ST ↑ II, III avF T↑ ST↑ V1, V4R	Hypokinetic IW , RV 44 %
44	55	F	74/min	120/80	25.1	ASMI	- ve	216	+ ve	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum EF 88.9%
45	55	F	68/min	110/70	19.6	ASMI	- ve	165	NEG	q V1-V6, ST↑ V1-V6 T ↓	Akinetic AW & septum, poor LV compliance
46	55	F	58/min	114/72	25.6	IWMI	- ve	200.8	+ ve	ST ↑ II, III avF T↑	Hypokinetic IW EF 54 % MR likely
47	60	F	82/min	116/66	20.3	ASMI	- ve	168	NEG	ST ↑ T ↑ V1-V6, reciprocal in II, III avF	Hypokinetic AW & septum poor LV function EF 38 %
48	60	F	48/min	120/84	25.4	IWMI with heartblock	- ve	204	+ ve	ST ↑ II, III avF T↑, Heart Block	Hypokinetic IW EF 54 %
49	60	F	68/min	100/70	24.2	ASMI	- ve	176	NEG	ST ↑ T ↑ V1-V6	Akinetic AW & septum EF 59.2 %
50	60	F	74/min	110/68	26.5	IWMI	- ve	215	+ ve	ST ↑ II, III avF	Hypokinetic IW EF 53.8 %

MASTER CHART - CONTROLS

No	Age	Sex	Pulse	BP(mmHg)	B.M.I	Total Cholestrol	Smoking	Microalbuminuria	ECG changes
1	30	M	74/min	100/84	22	165	+ve	Neg	Normal
2	32	M	82/min	114/76	20	173	-ve	Neg	Normal
3	35	M	84/min	118/72	25.8	184	+ve	Neg	Normal
4	35	M	66/min	110/78	21	168	+ve	Neg	Normal
5	35	M	72/min	120/82	19	138	-ve	Neg	Normal
6	37	M	75/min	114/78	23	179	-ve	Neg	Normal
7	39	M	68/min	116/80	22	156	+ve	Neg	Normal
8	40	M	65/min	114/76	24	176	+ve	Neg	Normal
9	40	M	74/min	110/72	26.3	173	-ve	Neg	Normal
10	41	M	82/min	116/86	23	191	-ve	Neg	Normal
11	42	M	94/min	114/72	25.4	214	+ve	Neg	Normal
12	42	M	88/min	112/86	20	164	-ve	Neg	Normal
13	43	M	84/min	112/82	24	193	+ve	Neg	Normal
14	45	M	78/min	116/76	23	176	-ve	Neg	Normal
15	45	M	85/min	120/78	27	185	-ve	Neg	Normal
16	46	M	73/min	116/72	22	178	+ve	Neg	Normal
17	48	M	68/min	118/84	20	168	-ve	Neg	Normal
18	48	M	75/min	110/72	24	212	+ve	Neg	Normal
19	50	M	65/min	114/74	23	184	+ve	Neg	Normal
20	50	M	60/min	110/86	24.16	175	+ve	+ ve	Normal
21	50	M	74/min	116/76	27	203	+ve	+ ve	Normal
22	50	M	82/min	112/82	22	165	-ve	Neg	Normal
23	52	M	71/min	110/74	25.5	168	+ve	+ ve	Normal
24	54	M	68/min	100/82	26	176	+ve	+ ve	Normal
25	55	M	76/min	116/76	24	153	-ve	Neg	Normal
26	55	M	77/min	118/72	21	209	+ve	+ ve	Normal
27	58	M	84/min	100/86	20	204	-ve	Neg	Normal
28	58	M	90/min	118/76	26.3	178	+ve	+ ve	Normal
29	58	M	65/min	100/76	24	194	+ve	+ ve	Normal
30	60	M	68/min	114/86	22	187	+ve	+ ve	Normal
31	40	F	73/min	116/86	20	176	-ve	Neg	Normal
32	43	F	78/min	100/76	21	164	-ve	Neg	Normal
33	45	F	84/min	116/72	20	156	-ve	Neg	Normal
34	48	F	81/min	114/86	23	154	-ve	Neg	Normal
35	50	F	80/min	100/78	22	183	-ve	Neg	Normal
36	50	F	78/min	118/74	20	175	-ve	Neg	Normal
37	50	F	74/min	116/76	19	167	-ve	Neg	Normal
38	55	F	68/min	100/84	20	154	-ve	Neg	Normal
39	55	F	75/min	112/86	23	148	-ve	Neg	Normal
40	55	F	68/min	116/76	22	152	-ve	Neg	Normal
41	55	F	82/min	100/82	21	162	-ve	Neg	Normal
42	55	F	76/min	100/70	20	174	-ve	Neg	Normal
43	55	F	85/min	112/80	21	177	-ve	Neg	Normal
44	55	F	88/min	116/70	25.45	183	-ve	Neg	Normal
45	55	F	90/min	118/84	21	158	-ve	Neg	Normal
46	55	F	68/min	100/70	20	146	-ve	Neg	Normal
47	60	F	75/min	120/80	26	152	-ve	+ ve	Normal
48	60	F	76/min	116/72	25	157	-ve	+ ve	Normal
49	60	F	84/min	100/70	21	206	-ve	Neg	Normal
50	60	F	80/min	118/82	19	182	-ve	Neg	Normal